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**BP'S RESPONSE TO DEADLINE 3**

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## Deadline 3 submission

### BP'S RESPONSE TO DEADLINE 3

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#### 1. OVERVIEW

- 1.1 At Deadline 2, BP Exploration Operating Company Limited ("bp") submitted its response to a number of submissions made by Orsted Hornsea Project Four Limited ("Orsted") at Deadline 1 and (where relevant) to the Examining Authority's ("ExA") first written questions (Examination Library ref: [REP2-062](#)).
- 1.2 As part of its response to Deadline 2, bp further advised that it intended to submit certain additional submissions at Deadline 3, specifically:
- 1.2.1 bp's response to the report prepared by the Energy Transition Alliance entitled 'Northern Endurance CCUS Co-location Review', commissioned by Orsted and submitted to the Planning Inspectorate as Appendix 1.1 of the position statement between Orsted and bp submitted at Deadline 1 ([REP1-057](#) (electronic page number 20)); and
  - 1.2.2 a copy of the Interface Agreement (as defined in that submission) ("IA"), together with a summary of its terms and justification for its disapplication pursuant to bp's proposed protective provisions.<sup>1</sup>
- 1.3 These have been included as Appendices 1 to 3 of this submission and are discussed further below.
- 1.4 In addition, bp has further included within this response to Deadline 3:
- 1.4.1 the written summary of oral case and associated submissions from bp's participation at Issue-Specific Hearing 1 ("ISH1") on 12 April 2022 (Appendix 4);
  - 1.4.2 a legal note on the consenting process and the associated timescales for the offshore components of the NEP project (Appendix 5); and
  - 1.4.3 a response to Orsted's response to question INF.1.2 of the ExA's first written questions (showing bp's response underneath Orsted's response for the ExA's ease of cross-reference) (Appendix 6 to this document).
- 1.5 bp notes that subsequent to ISH1, the ExA issued a Rule 17 letter requesting bp to submit *"any further evidence, including any further legal submissions and supporting evidence, considered necessary to justify why the Interface Agreement should be disapplied by Deadline 4"*. bp considers that Appendix 3 to this submission provides such information; however, will consider whether any further updates/submissions are necessary at Deadline 4, including in response (where necessary) to any submissions made by Orsted at Deadline 3.

#### 2. BP'S RESPONSE TO ORSTED'S TECHNICAL REPORT

- 2.1 At Deadline 1, Orsted submitted a joint position statement agreed between Orsted and bp (Examination Library ref: [REP1-057](#)) (the "Position Statement"). Orsted and bp each separately appended (Appendices 1 and 2 respectively) to the Position Statement their individual positions with regard to the potential for coexistence between Hornsea 4 and the

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<sup>1</sup> TCE confirmed to bp that no redactions were required to the terms of the Interface Agreement prior to its submission into the Hornsea Project Four examination.

NEP Project (both as described in the Position Statement) within an overlapping area of seabed (the "Overlap Zone").

- 2.2 Each party included their own technical report within their respective Appendices to the Position Statement, and bp provided initial comments in response to Orsted's submissions on the respective technical reports in Sections 5.2 and 5.3 of its Deadline 2 submission ([REP2-062](#) (electronic pages 6 to 8)).
- 2.3 bp now further provides its more substantive comments on Orsted's technical report as Appendix 1 to this submission. As that Appendix explains, much of the analysis in Orsted's technical report is consistent with and complementary to bp's position. Importantly, Orsted's technical report does not conclude that co-location within the entirety of the Overlap Zone is, in fact, feasible. Indeed, none of the expert analysis that has so far been put before the ExA would support such a conclusion, and the authors of the report are careful not to suggest that they have identified a solution to the serious obstacles that are acknowledged to exist.
- 2.4 bp's response draws attention to several important limitations in the scope and content of the Orsted technical report, which must be taken into account when assessing its contents and determining what weight can be given to its analysis.
- 2.5 Where there are material differences in the assessments undertaken by bp and the ETA on behalf of Orsted, bp's response in Appendix 1 explains why bp's assessment is more complete, up-to-date and robust, and is therefore to be preferred.
- 2.6 For those reasons Orsted's technical report does not alter bp's position as to the potential for the two projects to co-exist within the entirety of the Overlap Zone, or as to the provision that should be made within the DCO in order to address this.

### 3. THE INTERFACE AGREEMENT

- 3.1 bp set out in section 15 of its submission at Deadline 1 (Appendix 2 to the Position Statement discussed above) the background to and purpose of the IA, as well as explaining why it was necessary and appropriate in the public interest to disapply this agreement under the terms of the protective provisions proposed by bp as part of that submission (Appendix 2).
- 3.2 Orsted raised a number of criticisms in response to these particular submissions as part of its Deadline 1 submissions, to which bp in turn responded in Appendix 2 to its Deadline 2 submission ([REP2-062](#)).
- 3.3 bp noted as part of its Deadline 2 submission that it was continuing discussions with The Crown Estate ("TCE") with a view to providing the ExA with a copy of the IA, along with a summary of its terms and a fuller justification for its disapplication. Further to these discussions, TCE have now confirmed they are content with its disclosure (and that no redaction to its terms is required) and bp accordingly includes at Appendix 2 to this submission a copy of the agreement and at Appendix 3 a summary of its terms for the ExA's ease of reference, together with corresponding commentary on why it is appropriate to disapply its effect pursuant to bp's proposed protective provisions (as included at Annex 3 to bp's Deadline 2 submission) ([REP2-062](#)).

**APPENDIX 1**

**BP'S RESPONSE TO THE OREC/NZTC REPORT**

21 April 2022

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**BP'S RESPONSE TO THE 24 JANUARY 2022  
NORTHERN ENDURANCE CCUS CO-LOCATION REVIEW REPORT  
PREPARED BY OFFSHORE RENEWABLE ENERGY CATAPULT AND  
NET ZERO TECHNOLOGY CENTRE**

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## 1. INTRODUCTION

- 1.1 BP Exploration Operating Company Limited (“bp”), as the operator of the Northern Endurance Partnership (“NEP”) project, has reviewed the report prepared by the Energy Transition Alliance (“ETA”), a consortium of Offshore Renewable Energy Catapult (“OREC”) and Net Zero Technology Centre (“NZTC”) as well as working partner Xodus, entitled ‘Northern Endurance CCUS Co-location Review’ (the “OREC/NZTC report”), and submitted to the Planning Inspectorate on 8<sup>th</sup> March 2022 within Appendix 1.1 of the position statement between Hornsea Project Four and bp submitted at Deadline 1 ([REP1-057](#) (electronic page number 20)). The OREC/NZTC report was commissioned by Orsted in response to bp’s report, ‘A Technical Assessment of the Endurance Reservoir and Hornsea Project Four Wind Farm’ (“bp Technical Assessment”), which was provided to Orsted, The Crown Estate (“TCE”), BEIS and the Oil and Gas Authority (“OGA”, which is now known as the North Sea Transition Authority (“NSTA”)) in December 2021 and submitted to the Planning Inspectorate on 8<sup>th</sup> March 2022 within Annex 1 of bp’s Deadline 1 submissions ([REP1-057](#), Appendix 2 (electronic page number 146)).
- 1.2 The bp Technical Assessment addresses many of the issues discussed in the OREC/NZTC report, and rather than reproducing in this document relevant materials from the bp Technical Assessment, bp identifies below relevant sections of the bp Technical Assessment that should be read in conjunction with bp’s comments on the OREC/NZTC report. Where appropriate, bp also refers below to relevant parts of its Deadline 1 submission ([REP1-057](#), Appendix 2 (electronic page number 115)) (the “bp Deadline 1 Submission”).
- 1.3 bp welcomed this opportunity to review the OREC/NZTC report, and to respond to the work the ETA has undertaken in producing the report commissioned by Orsted. As noted in bp’s Deadline 1 Submission<sup>1</sup>, and discussed in more detail in this document, much of the analysis in the OREC/NZTC report is consistent with and complementary to what is in the bp Technical Assessment. However, there are some aspects of the OREC/NZTC report that bp does not agree with, and to the extent there are material differences in the conclusions and findings in the OREC/NZTC report and bp’s Technical Assessment, they are addressed within this document<sup>2</sup>.
- 1.4 bp believes that it is important, when reviewing the OREC/NZTC report, to understand both the basis on which that report was prepared, and what the report does (and does not) do.
- 1.5 The Introduction section of the OREC/NZTC report states that:
- 1.5.1 TCE commissioned ETA to “*carry out a comprehensive and unbiased study to examine the additional risks that may result from overlapping of Offshore Wind and CCUS projects and how those risks may be managed*”<sup>3</sup>. This Project Vulcan work (in which bp, representing the NEP project, participated) was undertaken during 2021 and is referred to in paragraph 8.2 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2 (electronic page number 130));
- 1.5.2 Orsted subsequently contracted the ETA to “*expand on the high-level recommendations outlined within project (sic) Vulcan and develop site specific solutions and recommendations based on the existing sites of Orsted’s Hornsea*”

<sup>1</sup> [REP1-057](#), Appendix 2, Paragraphs 8.2 – 8.4 (electronic page numbers 130 and 131)

<sup>2</sup> bp addresses in this document what it considers to be the most important points rather than identifying every instance where there is disagreement. Accordingly, the Examining Authority should not assume that the absence of a specific response to a particular point in the OREC/NZTC report means that it is agreed or accepted by bp. To the extent that the Examining Authority has questions about specific elements of the OREC/NZTC report that are not addressed in this report, bp would, of course, be happy to respond to such questions and provide additional information.

<sup>3</sup> [REP1-057](#), Appendix 1.1 (electronic page number 31)



*4 offshore wind development and BP's CCUS Northern Endurance project situated approximately 70 km off the Yorkshire coast, UK."*<sup>4</sup>

- 1.6 Elsewhere in the report, the work commissioned by Orsted is described as a study "to examine the risks highlighted within Project Vulcan in a real-world example"<sup>5</sup>.
- 1.7 Importantly, the premise of the OREC/NZTC report is that co-location will occur. Accordingly, instead of considering whether Hornsea 4 and the development of the Endurance Store<sup>6</sup> could, in fact, co-exist or "co-locate" in the entirety of the Overlap Zone<sup>7</sup>, the OREC/NZTC report simply:
- 1.7.1 identifies various issues that co-location of the two projects might give rise to; and
- 1.7.2 discusses possible theoretical ways to approach those issues.
- 1.8 The limitations of the OREC/NZTC report are expressly recognised within the report itself. For example, in both the Executive Summary and Conclusions sections of the report the ETA makes clear that: (i) currently there is limited information concerning (and understanding of) the impact of co-locating CCUS and offshore wind projects; and (ii) further studies and work would need to be undertaken to determine whether the report's suggestion that co-location could occur using "a standard minimum square grid formation of 1 turbine every 2 km" would, in fact, be possible:

*"Although the report provides context and answers to many of the original questions, the ETA has concluded that while there is information available on the individual aspects of CCUS and Offshore Wind there is a lack of literature on, and therefore understanding of, the impact of co-locating projects. This is specifically around the impact of turbine layout and noise on MMV [measurement, monitoring and verification] activities and how to monitor plume development away from the wells. Further studies are required before a definitive conclusion can be made. Until these issues have been addressed, a standard minimum square grid formation of one turbine every 2 km would need to be implemented. This relates to around nine diameters of the proposed turbines and would allow for rig access and opens the potential to use towed streamer acquisition for monitoring storage conformance and CO2 plume development away from the wells. This would be unless the cost of Ocean Bottom Node technology can be justified/reduce or a series of other MMV technologies can be compiled to provide full coverage. This layout would need to be investigated by the wind and CCUS operator to identify if this is feasible and economical for the project to continue."*<sup>8</sup> (emphasis added)

- 1.9 In reviewing the OREC/NZTC report, it also is important to bear in mind the following:
- 1.9.1 although bp's Technical Assessment was provided to Orsted in December 2021 and the OREC/NZTC report is dated 24 January 2022, the OREC/NZTC report does not refer to, review or respond to the bp Technical Assessment. Accordingly, in the OREC/NZTC report the ETA does not question or challenge the findings or conclusions in the bp Technical Assessment;
- 1.9.2 although the ETA, for purposes of preparing the OREC/NZTC report, gathered information from Orsted about Hornsea 4 (with the ETA setting out "selected

<sup>4</sup> [REP1-057](#), Appendix 1.1 (electronic page number 31)

<sup>5</sup> [REP1-057](#), Appendix 1.1 (electronic page number 24)

<sup>6</sup> See section 6.1 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page number 167) for the description of the Endurance Store

<sup>7</sup> The "Overlap Zone" refers to the area of seabed in relation to the Endurance saline aquifer which is subject to an agreement for lease granted by The Crown Estate to bp that overlaps with the area of seabed which is subject to an agreement for lease granted by TCE to Orsted for Hornsea 4.

<sup>8</sup> [REP1-057](#), Appendix 1.1 (electronic page numbers 24 and 88)

*information*” in Section 2.2 of the report<sup>9</sup>), in preparing the OREC/NZTC report the ETA did not approach bp and seek to obtain information from bp about the NEP’s development of Endurance;

- 1.9.3 although Section 3 (Measuring, Monitoring, and Verification) (“MMV”) of the OREC/NZTC report refers to *“interviews with supply chain members and regulatory authorities”*<sup>10</sup> being conducted for purposes of the report, the report does not identify who was interviewed or set out in full the information provided;
  - 1.9.4 the OREC/NZTC report’s analysis of what theoretically might be possible in terms of MMV for the NEP project is based on the ETA’s *“inference of likely activities”* based on its *“review of the MMV plan proposed by the White Rose project”*<sup>11</sup>. The use of that plan from 2016, and *“inferences”* drawn from it, indicates the OREC/NZTC report does not take account of the extensive site specific information about Endurance and its development plan as described in the bp Technical Assessment or reflect the detailed review and assessment of that information and plan undertaken during Orsted’s and bp/NEP’s discussions and collaboration over the course of the last two years.
- 1.10 In addition to the various limitations associated with the OREC/NZTC report, it is noteworthy that the OREC/NZTC report:
- 1.10.1 does not conclude that co-location within the Overlap Zone is, in fact, feasible;
  - 1.10.2 does not conclude that it would, in fact, be possible to use 3D towed streamers as the means of carrying out MMV for Endurance in the event that co-location occurred. All the report concludes is that the ETA’s co-location “proposal” (i.e. to implement a standard minimum square grid formation of 1 turbine every 2km) ***“opens the potential to use towed streamer acquisition for monitoring storage conformance and CO2 plume development away from wells”***. (emphasis added);
  - 1.10.3 does not conclude that (in the event co-location occurred) it would be appropriate to use Ocean Bottom Node (“OBN”) technology for monitoring purposes in the Overlap Zone;
  - 1.10.4 does not confirm that (in the event co-location occurred) there are monitoring technologies (other than 3D towed streamers) that would provide the degree of quality and repeatability of seismic imaging and data that bp/NEP needs in order to satisfy operator and regulatory obligations;
  - 1.10.5 states that co-location presents a *“real challenge for the CCUS and OW [Offshore Wind] operators as co-location adds a huge area of uncertainty into the development and operation of these projects”*<sup>12</sup> and then notes that this *“offers a huge opportunity for the supply chain to rise to the challenge of creating cost effective and innovative solutions to the issues identified within this report”*. However, the OREC/NZTC report does not itself identify any solution(s) that it has determined would, if implemented, overcome the Overlap Zone related challenges currently facing the NEP and Hornsea 4 projects.
- 1.11 bp has carefully reviewed and considered the OREC/NZTC report. Nothing in the report alters:
- 1.11.1 the conclusion of bp and its NEP co-venturers that co-existence across the entirety of the Overlap Zone by locating wind turbines on top of or near to the

<sup>9</sup> [REP1-057](#), Appendix 1.1 (electronic page number 34)

<sup>10</sup> [REP1-057](#), Appendix 1.1 (electronic page number 38)

<sup>11</sup> [REP1-057](#), Appendix 1.1 (electronic page number 42)

<sup>12</sup> [REP1-057](#), Appendix 1.1 (electronic page number 81)

Endurance store is not feasible for delivering the East Coast Cluster<sup>13</sup> (“ECC”) plan; and, by consequence,

- 1.11.2 their request for protective provisions in the Hornsea 4 DCO which would prevent the construction of wind infrastructure in the Exclusion Area (as defined in bp’s proposed Protective Provisions ([REP2-062](#), Annex 3 (electronic page number 20))).

## 2. SECTION 3 – “MEASURING, MONITORING, AND VERIFICATION (MMV) SURVEY INTERACTION

- 2.1 Section 3 of the OREC/NZTC report discusses various means of carrying out MMV and what, in theory, might be possible in terms of MMV if co-location occurred involving an offshore wind farm and a CCS project. bp recommends that Section 3 of the OREC/NZTC report be read in conjunction with section 7.3 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1, (electronic page numbers 190 – 197) and sections 7.1 – 7.7 and 8.1 – 8.8 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2, (electronic page numbers 128 – 132)).
- 2.2 In reading Section 3 of the OREC/NZTC report, it is important to understand that what OREC/NZTC did was “**conduct desktop research into available MMV technologies that could be used for the Northern Endurance project while carrying out stakeholder engagement with industry experts to provide detailed current information**”<sup>14</sup> (emphasis added) and “**explore the primary subsurface characteristics of the Northern Endurance store and highlight MMV technologies that could be used to survey the store based on interviews with supply chain members and regulatory authorities**” (emphasis added)<sup>15</sup>.
- 2.3 Accordingly, the focus in Section 3 is discussion of MMV technologies. However, Section 3 of the report does not discuss or address what the December 2021 bp Technical Assessment says about why various MMV technologies would not be able to be used for the Endurance store.

### **Sub-Section 3.2 – “Monitoring, Measurement and Verification (MMV) Plans”**

- 2.4 Page 12 of the OREC/NZTC report discusses the importance of a monitoring plan, and states the following:
- “A monitoring plan is an essential component of the application for a CO2 storage permit. Monitoring is necessary to define a baseline, to ensure conformance to predicted behaviour and to verify containment of stored CO2. Based on the subsurface characterisation of the storage site, monitoring and measurement is designed to provide for early detection and recognition of irregularities to activate contingent actions.*

...

*The monitoring plan will be site specific, informed by the findings from site characterisation and risk assessment, and dependent on size, shape, and type of storage structure (depleted hydrocarbon or saline aquifer).*

...

*Feedback from the monitoring plan is invaluable and allows history matching the dynamic simulation models to predict future behaviour of CO2 more accurately in the storage complex. ...”<sup>16</sup>*

<sup>13</sup> See section 1.1 of the bp Deadline 1 Submission for a description of the East Coast Cluster ([REP1-057](#), Appendix 2 (electronic page number 119)).

<sup>14</sup> [REP1-057](#), Appendix 1.1 (electronic page number 31)

<sup>15</sup> [REP1-057](#), Appendix 1.1 (electronic page number 38)

<sup>16</sup> [REP1-057](#), Appendix 1.1 (electronic page number 42)

- 2.5 bp agrees with these statements concerning the purpose and fundamental importance of a MMV plan for a CCS project (and notes that the statements from page 12 that are quoted above effectively reproduce portions of Appendix 2 of the NZTC’s “Carbon dioxide and storage permit application guidance” (the “NZTC Guidance”) (see Annex 2 to Appendix 5 of bp’s Deadline 3 submission)).
- 2.6 bp explained in the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1, section 7.3 (electronic page numbers 190 – 197)) and its Deadline 1 Submission ([REP1-057](#), Appendix 2, sections 8.7 – 8.8 (electronic page number 131)) that time-lapsed seismic imaging is viewed as the only data that will provide operators and regulators with the necessary confidence about containment and conformance to allow liability to be transferred, with it taking at least 20 years after closure of the storage site until liability could be transferred.
- 2.7 The following statements in sub-section 3.2.1 of the OREC/NZTC report discussing the phases of monitoring indicate the ETA recognises and agrees with the importance of time lapse seismic in sufficiently proving containment and conformance of the CO<sub>2</sub> plume so as to allow post closure transfer of liability to occur:
- “Injection - ...**
- Monitoring plume development from the injection wells is a key indicator of storage site behaviour. Measuring response at wells to update reservoir models and time lapse seismic are the main technologies capable of demonstrating conformance.*
- Post Injection - ...**
- The plume will continue to migrate after injection with time lapse seismic providing confirmation.*
- Post Closure - ...** *Time lapse seismic could be used to confirm the migration of the CO<sub>2</sub> plume if required. ...*
- After Transfer –** *Monitoring and measurement tasks continue for 30 years<sup>17</sup> to confirm long term suitability in accordance with 2009/31/EC CCUS Directive.<sup>18</sup>*
- 2.8 In discussing theoretical MMV methods, sub-section 3.2.2 of the OREC/NZTC report includes Table 3 which is described as listing “*the proposed monitoring methods for the White Rose development by monitoring domain*”<sup>19</sup>.
- 2.9 The 2016 White Rose MMV plan was based on the Endurance store being developed as a UK government sponsored CCS demonstration project. That project was of a very different nature to the NEP project which involves developing the Endurance store as the enabler for the ECC plan for industrial decarbonisation in service of the UK’s Clean Growth and Net Zero strategies. For example, the development of Endurance by NEP will use much more of the capacity of the Endurance store and is a phased development with many more CO<sub>2</sub> injector wells than was envisaged by the White Rose project. The increased number of injector wells means the MMV needs across the entire Endurance store are more significant by comparison. For example, particular 3D seismic monitoring, which provides a time-lapsed 4D image of CO<sub>2</sub> in the store, is needed in order to ensure the additional wells are correctly located in the Endurance store.
- 2.10 Although the White Rose project and NEP project both involve the Endurance store, the projects differ significantly in nature and bp believes that the OREC/NZTC report’s

<sup>17</sup> bp notes that the operator must monitor for at least 20 years post closure of the storage site, at which point it can apply to hand the licence back and once accepted the authorities become responsible for ongoing monitoring obligations.

<sup>18</sup> [REP1-057](#), Appendix 1.1 (electronic page numbers 42 – 43)

<sup>19</sup> [REP1-057](#), Appendix 1.1 (electronic page number 43)

discussion in Section 3 of possible MMV options for the development of Endurance is of limited value given:

- 2.10.1 it is based upon: (i) a 2016 MMV plan proposed for the Endurance store as part of a project that is materially different from the NEP project; and (ii) ETA's "inference of likely activities" is based on its review of the White Rose Plan<sup>20</sup>;
  - 2.10.2 the report does not take account of specific information relating to the Endurance Store resulting from work and analysis that was undertaken during the last 2 years concerning how the Endurance Store will be developed by NEP and what that means in terms of the MMV needs for Endurance as part of the NEP project<sup>21</sup>; and
  - 2.10.3 the OREC/NZTC report recognises that MMV plans need to be site specific and are dependent on various factors:  
*"The monitoring plan will be site specific, informed by the findings from site characteristics and risk assessment, and dependent on the size, shape and type of storage structure (depleted hydrocarbon or saline aquifer)."*<sup>22</sup>
- 2.11 Section 3.2.2 of the OREC/NZTC report states that per the White Rose MMV plan:  
*"Four monitor surveys were proposed over the lifecycle of the storage site based on the fact that plume development and migration of the CO<sub>2</sub> is not critical for the operation of injection wells"*<sup>23</sup>.
- 2.12 In respect of the statement "*plume development and migration of the CO<sub>2</sub> is not critical for the operation of injection wells.*", bp agrees that once an injection well is in place, the migration of CO<sub>2</sub> and development of the CO<sub>2</sub> plume does not affect how that well operates in terms of how CO<sub>2</sub> is injected into that well. However, as explained in section 6.3 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1, (electronic page numbers 168 – 170), knowing how CO<sub>2</sub> migrates and how the plume develops is relevant both to deciding where to locate other injection wells and to verification of the conformance and containment of the plume. Accordingly, plume development and migration of CO<sub>2</sub> is critical to the use and full field development of Endurance. Additionally, until injection occurs, it is not certain how CO<sub>2</sub> will migrate through the Endurance store and bp expects it is likely that there could be significant differences in well performance. Monitoring data would be important information for understanding what caused any differences in well performance, and therefore monitoring of plume development and migration of CO<sub>2</sub> also is important for the operation of the injection wells.
- 2.13 Sub-section 3.2.2 of the OREC/NZTC report states that "*The repeatability and quality of the 4D time lapse signal is one of the biggest concerns with the overlap of wind farms and*

<sup>20</sup> [REP1-057](#), Appendix 1.1 (electronic page number 42)

<sup>21</sup> In explaining that the OREC/NZTC report has relied upon a review of the MMV plan proposed for the White Rose project, the report states "*Access or knowledge to (sic) the current MMV plan for the Northern Endurance site was not available in the public domain at the time of this report.*" (page 12). However, as noted in the Introduction of this document: (i) ETA did not ask bp if it would provide information; and (ii) bp had provided the bp Technical Assessment (which contains a significant amount of information about the MMV needs of the NEP Project) to Orsted, TCE, BEIS and the OGA before the OREC/NZTC report was issued (and if Orsted had asked, bp would have agreed to Orsted sharing the bp Technical Assessment with ETA, and bp could have provided the ETA with additional information about the MMV plans for Endurance).

<sup>22</sup> [REP1-057](#), Appendix 1.1 (electronic page number 42)

<sup>23</sup> [REP1-057](#), Appendix 1.1 (electronic page number 46)

CCUS sites especially for towed streamer acquisition”<sup>24</sup>. bp strongly agrees with this statement.

- 2.14 The report goes on to recognise that “*the installation of the wind farm could make it difficult for the seismic vessel to navigate....*”<sup>25</sup>. In fact, based on extensive studies and work carried out during the last two years, bp believes the difficulties in navigating through a wind farm means it would be impossible to acquire full coverage 3D towed streamer seismic.

### **Sub-Section 3.3.1 – “Reflection Seismic”**

- 2.15 Sub-section 3.3.1 of the OREC/NZTC report recognises the importance of time lapse 3D seismic acquisition for imaging the whole structure of a CO<sub>2</sub> store and states:

*“Reflection seismic (towed streamer or ocean bottom nodes) in the form of 3D acquisition for time lapse studies is currently viewed as the most applicable and mature technology to monitor the impact of CO<sub>2</sub> injection on plume migration and assessment of store and well integrity. ...*

*Seismic has the advantage over other methods as it can image the whole complex area including reservoir, overburden and surroundings. Providing the reservoir characteristics are suitable the seismic response is sensitive to changes in fluids content, i.e. CO<sub>2</sub> replacing brine, and to significant changes in pore pressure. This makes that technique useful for monitoring storage site integrity and reservoir over time.*

***Towed streamer is the most efficient and cost-effective method of gathering seismic data, especially over large areas like the Northern Endurance Storage Site.***<sup>26</sup>  
(emphasis added)

- 2.16 bp agrees with these statements, and for reasons explained in the bp Technical Assessment and the bp Deadline 1 Submission<sup>27</sup>, bp believes that 3D reflection seismology is the only way to reliably image the Endurance store, complex and overburden.
- 2.17 Sub-section 3.3.1 of the OREC/NZTC report goes on to discuss ocean bottom nodes (“OBN”) on the basis that “... *in the presence of wind farms this [towed streamer] might not be the most appropriate acquisition method with the challenges outlined above.*”<sup>28</sup>.
- 2.18 bp agrees with much of what is said on pages 16 – 18 of the OREC/NZTC report about OBN, namely that:
- the cost of acquiring OBN seismic is considerably higher than towed streamer acquisition. The OREC/NZTC report states the cost is “*approx. 10 times that of conventional 3D broadband data which is the current standard for towed streamer acquisition.*”<sup>29</sup>, and estimates that assuming four surveys over the lifecycle of the Endurance store, the extra costs would be in excess of \$100 million;
  - “*one of the limitations of ocean bottom acquisition is the often degraded image of the overburden*”<sup>30</sup>; and
  - although “*Advances in the speed of deployment and retrieval of ocean bottom nodes*” and “*development of autonomous nodes*” could reduce the cost of OBN

<sup>24</sup> [REP1-057](#), Appendix 1.1 (electronic page number 46)

<sup>25</sup> [REP1-057](#), Appendix 1.1 (electronic page number 46)

<sup>26</sup> [REP1-057](#), Appendix 1.1 (electronic page number 46)

<sup>27</sup> See sections 7.4 – 7.7 of bp’s Deadline 1 Submission ([REP1-057](#), Appendix 2, (electronic page numbers 128 – 129) and section 7.3 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 190 – 197)

<sup>28</sup> [REP1-057](#), Appendix 1.1 (electronic page number 46). bp understands the “challenges outlined above” to be the high cost of acquiring seismic data referred to in the first paragraph of Sub-section 3.3.1.

<sup>29</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

<sup>30</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

acquisition, “*These technologies are at a pre-commercial stage (Technology Readiness Level (TRL) 5/6) and undergoing sea trials and therefore still need to be proven in an operational environment.*”<sup>31</sup>

- 2.19 However bp does not agree that “... *ocean bottom surveys typically provide better data quality and imaging*”<sup>32</sup>. This is a generalised statement and is not applicable to the Endurance structure which is in shallow water (~60m) and has a relatively shallow crest (~1000m below seabed). Additionally, the seabed at Endurance is comprised of mobile sand waves, and that creates a major obstacle in terms of using ocean-bottom instruments to image the Endurance structure. The OREC/NZTC report appears to recognise that its general statement that “*ocean bottom surveys typically provide better data quality and imaging*” is not applicable to the Endurance structure since it goes on in sub-section 3.3.1 to refer to Figure 7 in the report identifying “*data gaps down to 500 ms ... seen on the section taken from ocean bottom cable data (pre 2012) acquired over Northern Endurance*”<sup>33</sup> and goes on to state the following in terms of the significance of this:
- “*This is a function of the spatial sampling of the receiver nodes and whilst this does not impact the imaging of the reservoir or storage site it **severely impacts the imaging of the shallow overburden** which could be important in the monitoring of CO2 conformance and containment.*”<sup>34</sup> (emphasis added)
- bp believes that the severe impact on the imaging of the shallow overburden not only “*could be*” but, in fact, would be important in terms of being able to appropriately monitor CO<sub>2</sub> conformance and containment.
- 2.20 The pre-2012 data referred to in the OREC/NZTC report comes from a survey WesternGeco conducted over Endurance in 1997 using ocean bottom instruments, namely ocean bottom cables (“OBC”). That survey encountered significant problems in terms of sand wave movement causing the cables on the seabed to move during data acquisition.
- 2.21 The impact of sand waves on the cabling WesternGeco used in 1997 is consistent with other problems caused by the large sand waves present in the area in which the Endurance store is located.
- 2.22 In addition to the issues caused by sand waves, as noted in the bp Technical Assessment the Endurance store is located in an area with strong tidal currents, with the dominant current changing direction every 12 hours<sup>35</sup>.
- 2.23 The large sand waves and tidal currents present at the Endurance seabed location are likely to have an even greater impact if OBN were used to acquire seismic (versus the OBC used in the WesternGeco survey). This is because of the nature of OBN instruments (compared to OBC) used on the seabed which means OBN are even more susceptible to moving (or being lost) where Endurance is located. In particular:
- 2.23.1 as noted in section 7.6 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2, electronic page number 128) (i) acquiring seismic using OBNs involves using marine vessels to deploy individual battery powered nodes on the seabed, with each node being the size of a small box; and (ii) for the Endurance aquifer several hundred to several thousand nodes would need to be installed as a network on the seabed (and each time a seismic acquisition operation occurred manned survey vessels would need to install and remove the OBNs). Each node is individually installed and retrieved which would involve a significant amount of lifting operations and can only be carried out in sea states conducive to such activities in the late spring/summer period. Conducting such operations amongst

<sup>31</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

<sup>32</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

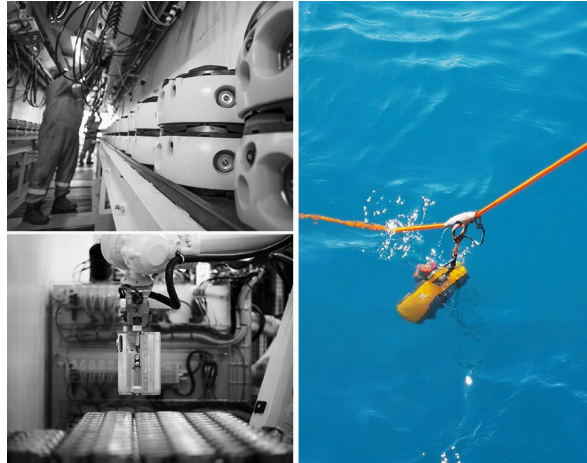
<sup>33</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

<sup>34</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

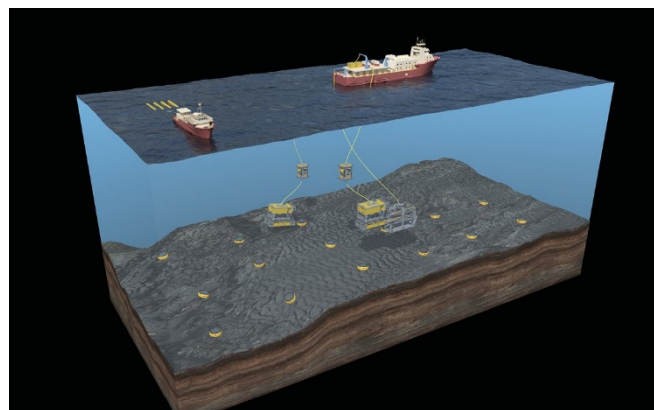
<sup>35</sup> [REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 195 – 196 (including Figure 34))

large rotating wind turbines which have, albeit very rarely, experienced detached blades that could hit objects in the nearby vicinity would compound the safety risk of carrying out OBN seismic operations if it was deployed for MMV.

- 2.23.2 The following images (which bp shared with Orsted, TCE, BEIS and the NSTA during a presentation in October 2021) show what OBNs look like and how they are deployed.



*Images showing nodes on vessel and where they are charged as well as an image showing the nodes being deployed by rope [GEO ExPro - Ocean Bottom Seismic: Robots on the Seabed](#)*



*Example ocean bottom node configuration and illustration of 3D image [GEO ExPro - Ocean Bottom Seismic: Robots on the Seabed](#)*

- 2.24 If sand waves/tidal currents cause OBNs to move so that they are not in the correct position, it will degrade the resulting quality of the seismic image, as some parts of the geology will be over sampled and others under sampled, and that impacts the amplitude of the response and the ability to analyse the data. This becomes an even greater concern when (as with the Endurance store) time-lapsed 4D occurs (versus carrying out a one-time survey using OBN) because a survey that does not reliably sample all of the geology affects the ability to accurately repeat the survey, which compromises the 4D signal and means it may not be possible to reliably prove containment of CO<sub>2</sub> within the store.
- 2.25 bp agrees with the statement in sub-section 3.3.1 of the OREC/NZTC report that the limitations of ocean bottom acquisitions would severely impact the imaging of the shallow overburden. However, bp does not agree with the claim in the report that the limitations of



ocean bottom acquisition “does not impact the imaging of the reservoir or storage site”<sup>36</sup>. The challenges that the shallow water and depth of the Endurance storage site, sand waves and tidal currents in the seabed location of the Endurance store create in terms of acquiring seismic imaging by using ocean bottom instruments apply equally to the area of the storage site, which means that data density and resolution imaging at the storage site also would be degraded if ocean bottom acquisition was used instead of towed streamer acquisition.

2.26 It also is important to note the following when reading the discussion in sub-section 3.3.1 of the OREC/NZTC report concerning the possible use of OBN, or OBC, for NEP’s development of Endurance:

2.26.1 the report does not provide any examples of an offshore CCS/CCUS facility in the world using OBN or OBC to acquire seismic imaging for purposes of MMV;

2.26.2 Appendix 2 of the NSTA Guidance (Annex 2 to Appendix 5 of bp’s Deadline 3 submission) includes information about what is required in terms of a “Storage Site and Storage Complex Monitoring Plan” supporting the application for a storage permit. The Guidelines identify seismic data monitoring as a type of monitoring measurement that could, at certain storage sites, be considered appropriate to detect the movement of injected CO<sub>2</sub>. In discussing seismic data monitoring, the NSTA Guidance expressly refers to the possible use of OBC to carry out monitoring, but only if they are permanently installed. As explained above, using OBC at Endurance is not feasible.

2.26.3 on page 17 of the OREC/NZTC report ([REP1-057](#), Appendix 1.1 (electronic page number 47) it is suggested that a permanent array might be deployed for purposes of “*stress and strain monitoring through the detection of microseismic events*”. Permanent arrays are also known as PRM (permanent reservoir monitoring). Essentially PRM involves leaving OBNs on the seabed for the lifetime of the project. As bp has described above, using OBNs is not feasible given the seabed and tidal current conditions where Endurance is located. The problems that exist in terms of using OBNs for a specific survey also apply to installing OBNs for the duration of the NEP project. Additionally, the batteries on each node only last for a matter of months, making permanent installation impractical.

2.26.4 The OREC/NZTC report also identifies other problems with using PRM that are not specific to Endurance:

“As with any technology there are important challenges to its [PRM’s] deployment

- *Initial investment cost of PRM is relatively large and may not offer sufficient benefit at an acceptable cost level*
- *The size of the array would be based on models. If model prediction of plume development is wrong and the plume extends outside the predicted area the array would lack the necessary coverage.*<sup>37</sup>

2.27 Based on the significant work and assessments undertaken by bp during 2019-2021 concerning the possibility of using ocean bottom seismic acquisition, bp has determined (for reasons explained above) that the imaging of the store and overburden at Endurance produced by using OBNs would be degraded as compared to using towed streamers. Shallow overburden imaging is not possible and the mobile seabed conditions arising from sand waves and the strong tidal currents create a real and significant problem in terms of being able to carry out reliable repeat ocean bottom seismic surveys (which in turn would

<sup>36</sup> [REP1-057](#), Appendix 1.1 (electronic page number 47)

<sup>37</sup> [REP1-057](#), Appendix 1.1 (electronic page number 50 - 51)

give rise to poor 4D repeatability, and potentially an inconclusive CO<sub>2</sub> containment assessment). Nothing in sub-section 3.3.1 of the OREC/NZTC report alters bp's conclusion that OBNs could not be used for monitoring purposes at Endurance (whether as the sole monitoring technology or as part of a "hybrid" approach of using OBNs and shorter towed streamers).

- 2.28 On page 18 of the OREC/NZTC report the discussion moves away from various issues concerning ocean bottom acquisition and raises the possibility of acquiring towed streamer data within a standard grid turbine layout, with the report stating that this "*may open the potential for the use of short offset acquisition like P-cable [12], or conventional 3D arrays with shorter streamers to acquire conventional 3D towed streamer data within a windfarm.*"<sup>38</sup>. The report does not suggest or find that this, in fact, could be done for Endurance. Instead, the report states that:

*"Before these techniques can be considered it is advised to carry out acquisition design modelling to look at potential sail configurations given the known challenges to understand what is possible in terms of acquisition and imaging, especially capturing the fluid effect of brine being replaced by CO<sub>2</sub>".*<sup>39</sup>

bp actually undertook such work during 2019-2021 whilst engaging in discussions with Orsted and others concerning the challenges of co-location and whether co-existence was possible in the entirety of the Overlap Zone:

- 2.28.1 For example, the possibility of using short-streamer (e.g. P-cable) acquisition was investigated in detail by bp. Streamer length determines the depth of imaging in the subsurface, and bp conducted tests on streamer lengths and concluded that very short streamers (e.g. 250m) do not provide imaging to the depth of the Endurance store. The safety margin required for towed streamers in areas of obstacles assumes a maximum offset at the end of the streamer of 45°, thus the safety margin required on both sides of the turbines is 0.707\*streamer length. bp's work determined that minimum streamer length for good quality imaging at Endurance is 1.5km, making the safety margin a 1km radius around each turbine. 3D seismic data cannot be acquired with 2km wide "gaps" around each turbine where no seismic data is collected. That means the only option would be to collect 2D seismic data. Again, this option was investigated and the bp Technical Assessment<sup>40</sup> explains that bp concluded (using test seismic data acquired for Endurance in 2020) that the tidal currents in the area are too changeable and repeatability of 2D lines to acquire a time-lapse image is very poor. Additionally, although 2D lines of seismic can be useful as interim monitoring data, they do not provide the required level of confidence that a complete, 3D image does and 2D lines of seismic cannot replace 3D surveys.

- 2.28.2 bp has also carried out seismic rock property modelling of CO<sub>2</sub> replacing brine to understand what resolution of seismic data is required for the Endurance store. The Bunter sandstone, which is the CO<sub>2</sub> store reservoir, is a very thick (~250m) good quality sandstone, but within this sandstone there are many small scale variations in rock quality that will impact the distribution of the CO<sub>2</sub>. The CO<sub>2</sub> will preferentially move through rock where it is easiest to (high porosity and permeability). The existing seismic data over the store was obtained from a sparse or low density survey, and bp's work determined that with low resolution seismic (which is the output that would come out of using a sparse or low density survey to image the store), bp would not be able to accurately position CO<sub>2</sub> within the reservoir. This is because with a sparse or low density survey of the Endurance store, CO<sub>2</sub> in thin layers is missed and the top and base of the plume are not correctly identified. Accordingly, high resolution seismic data is needed to

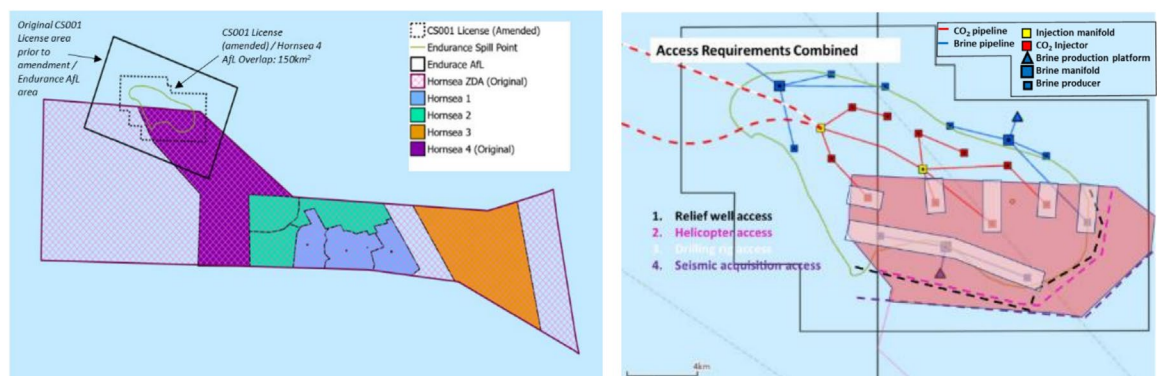
<sup>38</sup> [REP1-057](#), Appendix 1.1 (electronic page number 48)

<sup>39</sup> [REP1-057](#), Appendix 1.1 (electronic page number 48)

<sup>40</sup> See section 7.3 ([REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 190 – 197))

ensure that CO<sub>2</sub> is accurately positioned in the store, and 3D High Resolution (3DHR) towed streamer seismic is the best available technology for reservoir monitoring<sup>41</sup>.

- 2.29 The discussion about ocean bottom instrument and towed streamer seismic monitoring in sub-section 3.3.1 of the OREC/NZTC report does not challenge, question, address or even note the findings and conclusions in bp's Technical Assessment. Those conclusions are that given the characteristics of the Endurance structure and location of the seabed and the regulatory requirement of NSTA that NEP prove containment of CO<sub>2</sub> within the store, repeated 3D towed streamer seismic acquisition over time ("time lapse" or "4D" monitoring) is the best available technology for reservoir monitoring and providing the high quality imaging that is required in terms of the location and containment of the CO<sub>2</sub> plume in the reservoir and confirmation of no leakage into the overburden or beyond the storage site (as described in sections 6.1 and 6.2 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page number 167))).



**Figure 1, access requirement 4, shows the minimum area requirements for towed streamer seismic acquisition.**

- 2.30 bp, in reaching its conclusion that time-lapse 3D seismic surveys need to be used for monitoring the Endurance reservoir, has extensively studied and assessed information and data about other possible means of monitoring (including various "emerging" technologies and techniques that are discussed in the OREC/NZTC report and commented on by bp later in this document). bp also has taken account of the operational and regulatory requirements NEP must satisfy. This includes the NSTA Guidance (see Annex 2 of Appendix 5 of bp's Deadline 3 submission), which includes various requirements for monitoring the CO<sub>2</sub> store, including the following:

*"Monitoring is necessary to establish an environmental baseline and to assess whether injected CO<sub>2</sub> is behaving as expected, and to detect if any unexpected migration or leakage occurs."*

and

*"The choice of monitoring technology will be site specific and based on best practice available at the time of design."*

and

*"The long-term monitoring plan must be able to identify any leakages or significant irregularities. The plan should be updated as necessary, taking account of risk analysis, best practice and technological improvements."*

<sup>41</sup> bp notes that: (i) the oil and gas industry uses similar monitoring technologies; and (ii), within that industry, 3D vessel towed streamer seismic acquisition would be considered to be the best available technology for reservoir monitoring of an area with the type of geological properties identified for the Endurance Store.

- 2.31 Time-lapse 3D seismic surveys provide the best available way to detect unexpected migration or leakage. No other technique can provide both the high sensitivity to CO<sub>2</sub> (expected response at CO<sub>2</sub> saturation >2% at Endurance) and the 3D view in subsurface as to where CO<sub>2</sub> is located and to thereby confirm containment in the store. For a location like Endurance with shallow water and a shallow store, and a highly mobile seabed (due to sand waves and strong tidal currents) which would displace ocean bottom instrumentation, towed streamer is the best available practice at this time, and it is expected to remain so.
- 2.32 NSTA requirements for the long-term monitoring plan are that it must be regularly reviewed and updated, based on acquired monitoring data and any technological improvements (see Annex 2 of Appendix 5 to bp's Deadline 3 submission). Many academics and companies are researching ways to monitor CO<sub>2</sub> injection. What new technologies could be available in 10 or 20 years is unknown. In the meantime, it is only after CO<sub>2</sub> injection occurs that the migration of the CO<sub>2</sub> plume can be assessed against the modelled predictions. This means that it is critical that monitoring of the Endurance complex, storage site and overburden be as extensive and reliable as possible and that no part of the Endurance structure is excluded from such monitoring. Injection into any part of the Endurance structure is dependent on having the ability to accurately monitor the whole of the structure.
- 2.33 Accordingly, the form of monitoring used must be the best available practice and proven in terms of being able to produce the data required to verify that the CO<sub>2</sub> plume's behaviour and containment are safe. The monitoring that NEP intends to use for developing Endurance is the only form of monitoring that satisfies these criteria, and nothing in the OREC/NZTC report changes the following conclusions from the bp Technical Assessment:

**“7.3.5 Monitorability: Conclusions**

*Monitoring of injection at Endurance is essential to demonstrate the safe storage of CO<sub>2</sub> and allow for economic phased development. This is the first project to use the Bunter sandstone for CO<sub>2</sub> storage so there are many remaining uncertainties in the subsurface, in particular the way the CO<sub>2</sub> will move through the sandstone and what barriers it may encounter along the way that will alter its course. These uncertainties require data and time to understand and mitigate against.*

*Containment of CO<sub>2</sub> within the store needs to be demonstrated throughout the project and at the end of injection for store liability to transfer safety to the state. The planning of new injectors and implementation of pressure management requires a full 3D view of the migration of CO<sub>2</sub> in the reservoir. The risks if reliable monitoring data is not available are very high – either expansion beyond phase 1 is not possible, severely limiting the amount of CO<sub>2</sub> stored, or injection has to completely stop in some or all of the wells if subsurface behaviour cannot be understood. A project of the scale of Endurance cannot be safely managed without it. The only option, apart from towed streamer, would be dense OBN, however it has not been demonstrated in industry that an OBN survey within a dense windfarm would provide reliable 4D results.”<sup>42</sup>*

- 2.34 bp believes that the Sleipner CCS project (offshore of Norway) is a useful and important benchmark for Endurance as Sleipner has been in operation for 25 years and is one of the most recognised examples of safe and reliable CO<sub>2</sub> injection. Sleipner uses towed streamers for time-lapse surface 3D seismic monitoring. The quality of the data obtained using this monitoring method showed that the migration of the CO<sub>2</sub> plume was different from the original model predictions. This was due to reservoir complexities encountered during injection operations. The repeated towed streamer surveys were instrumental in revealing the complex nature of the Sleipner reservoir and ensuring accurate CO<sub>2</sub> plume detection and mapping. It was the effectiveness of towed streamer monitoring that allowed this to occur. In particular, as noted above, towed streamer seismic monitoring is the best means of acquiring the high-resolution data that allows small changes in CO<sub>2</sub> saturation to

<sup>42</sup> [REP1-057](#), Appendix 2, Annex 1 (electronic page number 197)

be detected over time, which is critical to verifying containment and conformance of the CO<sub>2</sub> plume within a storage site.

**The OREC/NZTC report’s discussion of “emerging” technologies**

- 2.35 Pages 19 - 20 of the OREC/NZTC report discuss various technologies that the report states “*are emerging within processing of the seismic data that have the potential to allow sparse acquisition and therefore reduce costs*”<sup>43</sup>. bp has explained above why the work it carried out during 2019 – 2021 determined that sparse acquisition is not appropriate for NEP’s Endurance Project.
- 2.36 In the table below, bp comments upon the various “emerging” technologies and techniques discussed in the OREC/NZTC report and although the OREC/NZTC report does not suggest that any of the “emerging” technologies it identifies could or should be used for monitoring the Endurance store, bp also provides below a brief explanation of why each technology could not be used for NEP’s Endurance project.

Relevant Page in the OREC/NZTC Report I	Type of Emerging Technology/Technique	Bp’s comments
p19	<p><b>Mirror imaging</b> – the OREC/NZTC report states that it is “<i>another solution that may provide an alternative solution to improved imaging of the overburden without having to increase the number of nodes and costs.</i>”</p>	<p>Mirror imaging is a technique that can be used when processing data from ocean bottom nodes (OBN) to ‘pretend’ they are at a mirrored location <i>above</i> the sea surface not below the sea surface on the seabed, using multiple phases in the data. The mirror image is added to the traditional image to increase the amount of data at each point. In theory using mirror imaging could mean fewer OBN would be needed to image the subsurface, which would result in a cost reduction. However, there are two problems in terms of implementing this at Endurance: 1. In shallow water (such as at Endurance) the multiple phases of mirrored data are very close together. Only the first multiple can be used but it is difficult to separate this out from everything else. 2. The positioning of the data points is not the same for the traditional and mirrored image and this creates an added complication with inconsistent amplitude variations, which could cause problems for analysing the 4D signal in the data.</p>

<sup>43</sup> [REP1-057](#), Appendix 1.1 (electronic page number 48)

<p>p19</p>	<p><b>Compressive sensing</b> – the OREC/NZTC report states that compressive sensing is an <i>“enabler for sparse random ocean bottom seismic acquisition using reconstruction of the full azimuth wavefield. It has the potential to significantly reduce Ocean Bottom Node (OBN) survey acquisition and the volume of data required.”</i></p>	<p>The aim of compressive sensing is to reduce the amount of data that is needed to ‘solve’ the mathematical equation to create a seismic data point. This is done with sparser data acquired on an irregular grid. The irregularity is a necessity and is a complete change to current seismic acquisition techniques. During data processing different phases of data are combined to increase the number of usable data points.</p> <p>The OREC/NZTC report describes compressive sensing as a <i>“novel and innovative technology”</i>. bp agrees. Although it is something that could significantly change the way seismic data is acquired and processed, compressive sensing is largely theoretical, has very few proven real-world examples and currently is not proven for widescale use for 3D imaging. It also has not been tested for 4D imaging. Additionally, what information is available indicates compressive sensing only appears to work in a deep marine setting where the different phases have larger separation created by the thick water column. At Endurance, water depths are very shallow, and there is no information available to suggest that this unproven technology would work for NEP’s Endurance project.</p>
<p>p19</p>	<p><b>Full Wavefield Migration</b> – the OREC/NZTC report states that this is <i>“another processing technique aimed at significantly reducing (sic) and therefore cost of ocean bottom nodes.”</i></p>	<p>Full wavefield migration to improve shallow imaging (the top ~500m of the subsurface) relies upon deriving velocities from multiple modes and phases of the data (the ‘full wavefield’) and using these velocities to derive reflectivity to make an image. The amplitude of seismic data is created by variations in velocity and density (2 independent properties of rock). With FWM the ‘image’ created is only velocity derived, so half of the 4D response is missing. Additionally, as noted in the OREC/NZTC report, to date FWM has been tested in deep water offshore of West Africa and has not been tried in shallow water. Given FWM has not been proven for use in shallow water, it could not be used for Endurance.</p>

pp19-20	<p><b>Gravity field monitoring</b> – the OREC/NZTC report states that “Gravimetry measurements ... offer the potential for accurate monitoring of the plume and seabed deformation (as a by-product of gravity metre deployment). ... This could be an applicable technology for saline aquifers where the density changes could be significant as the brine is replaced by CO2.”</p>	<p>As stated in the OREC/NZTC report, currently gravity is a “complement to a seismic monitoring programme.” It is not a replacement for, or alternative to, carrying out seismic imaging.</p>
p20	<p><b>Electromagnetism</b></p>	<p>The OREC/NZTC report states that Electromagnetism (EM) “was not considered as an applicable technology for a MMV within a wind farm.”</p> <p>bp agrees EM is not appropriate for MMV of Endurance.</p>

**Table 1: bp’s Comments on the “emerging technologies” discussed at pages 19 – 20 of the OREC/NZTC report**

**Sub-Section 3.3.2 – “Permanent Arrays and Passive Seismic”**

2.37 As explained above in paragraph 2.19, the seabed conditions at Endurance are not suitable for PRM.

2.38 In discussing PRM, the OREC/NZTC report states:

*“As with any technology there are important challenges to deployment*

- *Initial investment of a PRM is relatively large and may not offer sufficient benefit at an acceptable cost level*
- *The size of array would be based on models. If model prediction of plume development is wrong and the plume extends outside of the predicted area the array would lack the necessary coverage.”<sup>44</sup>*

<sup>44</sup> [REP1-057](#), Appendix 1.1 (electronic page numbers 50 – 51)

- 2.39 bp agrees with the above.
- 2.40 In terms of cost, in bp's experience PRM generally is only deployed in the oil and gas industry on very large, high income producing fields that require monitoring on an annual basis.
- 2.41 bp agrees about the importance of accurate modelling when PRM is used, and notes that in CCS projects, CO<sub>2</sub> will migrate through the store and therefore the method of monitoring needs to cover all eventualities. This includes having both baseline and monitor surveys that provide whole structure monitoring (i.e. complete coverage of the structure beyond spill point). This is particularly true for the Endurance project where NEP's development plan involves injecting significantly larger volumes of CO<sub>2</sub> than what was reflected in the 2016 MMV plan for White Rose, which is what was used as the basis for the OREC/NZTC report. Additionally, NEP's development of Endurance also involves the possibility of using brine production to manage pressure, which also could impact the CO<sub>2</sub> plume and is another reason why whole structure monitoring is a necessity for Endurance.
- 2.42 Page 21 of the OREC/NZTC report states that "*[t]he potential use of the wind turbines as a seismic source was mentioned in a few conversations and is an interesting concept that needs to be explored.*"<sup>45</sup> bp notes that currently the idea of using wind turbines as a possible seismic source is at an academic level and has never been trialled.
- 2.43 On page 21 of the OREC/NZTC report fibre optic cable and distributed acoustic sensing (DAS) are discussed. DAS is a system where fibre-optic cables are permanently installed in wells and can act as a seismic receiver for either earthquakes or active seismic sources shot in a pattern around the well (collecting data known as 'vertical seismic profiling' (VSP)). After extensive work and investigation, bp determined that the installation of DAS at Endurance was not suitable. This is primarily due to the fact that having a single fibre in one well and a reservoir at only 1000m depth means it would only be possible to image a small area (with bp's feasibility study showing that only a 1km radius of imaging would be achieved). However, modelling work carried by bp indicates injected CO<sub>2</sub> will be outside of this 1km radius within 5 years of injection starting. Accordingly, DAS is not a monitoring method that would be suitable for the long term monitoring that has to occur at NEP's Endurance project. Additionally:
- (A) NEP will be using a subsea development concept, which means the installation of DAS would be very expensive for the amount of data it would provide;
  - (B) For cost reasons, the microseismic (passive listening for very small movements in the subsurface) use for DAS discussed in the OREC/NZTC report would only be possible as a secondary objective; and
  - (C) The test cases mentioned in the OREC/NZTC report did not involve a marine environment, which have higher levels of background noise, and there is

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<sup>45</sup> [REP1-057](#), Appendix 1.1 (electronic page number 51)



uncertainty as to whether any microseismic events would be discernible in the light of the background noises in a marine environment.

### Sub-Section 3.3.3 – “Optimised Monitoring Strategies”

- 2.44 The OREC/NZTC report sets out, in sub-section 3.3.3, what is described as “*a conceptual view of an MMV strategy where the location of a wind farm limits the use of towed streamer acquisition*”<sup>46</sup>
- 2.45 The “concept” is “*Sparse PRM system focussed on injectors and early plume area.*”<sup>47</sup>
- 2.46 The OREC/NZTC report does not explain what its proposed “*sparse PRM system*” means nor does it provide details of what a “*sparse PRM system*” would involve. It fails to provide this information in terms either of a theoretical offshore CCS project or the Endurance store.
- 2.47 Nevertheless, for reasons explained elsewhere in this document, it is clear to bp that PRM (whether “*sparse*” or in any other form) cannot be used for purposes of the monitoring that will be necessary for NEP’s development of Endurance.
- 2.48 It is also important, when considering what is proposed in sub-section 3.3.3 of the OREC/NZTC report, to bear in mind that:
- 2.48.1 the “conceptual view” set out in the report is entirely theoretical. For example, the report itself states the conceptual view is based on “*information gathered from the public domain on technologies in play today and those potentially available in the future*”<sup>48</sup> (emphasis added);
  - 2.48.2 the theoretical “conceptual view” of using a sparse PRM system as the basis of the MMV strategy is for some form of unspecified “generic” project where “*the location of a wind farm limits the use of towed streamer acquisition*”<sup>49</sup>. The report does not state or suggest that:
    - (A) what is put forward as a “conceptual view” could, in fact, be undertaken either now or in the future (whether at NEP’s Endurance project or some other offshore CCS project in a location that also has a wind farm);
    - (B) the “conceptual view” set out at page 21 (or some other form of PRM), either could or should be used as the monitoring method for NEP’s Endurance project;
    - (C) it would be appropriate for NEP to adopt a MMV strategy for the Endurance site involving PRM;
    - (D) it would be possible for Hornsea 4 and Endurance to be co-located in the entirety of the Overlap Zone if NEP adopted a MMV strategy for the Endurance site based on using PRM. In fact, the following final bullet point of the description of the report’s “conceptual view” of a future MMV strategy for a location involving an offshore wind farm and CCS project makes it clear that the report is not saying either that a “sparse PRM system” would remove the need to also carry out towed streamer

<sup>46</sup> [REP1-057](#), Appendix 1.1 (electronic page number 51)

<sup>47</sup> [REP1-057](#), Appendix 1.1 (electronic page number 51)

<sup>48</sup> [REP1-057](#), Appendix 1.1 (electronic page number 51)

<sup>49</sup> [REP1-057](#), Appendix 1.1 (electronic page number 51)

acquisition or that using a hybrid of PRM and towed streamer acquisition would ensure that co-location could occur:

*“PRM system may minimise the requirements for towed streamer acquisition, the aerial extent could still impact co-location and turbine installation and therefore may not be an applicable solution”<sup>50</sup>*

### **Sub-Section 3.4 – “WTG Impact on MMV Surveys”**

2.49 bp agrees with the following statement in the OREC/NZTC report: *“Due to the high cost and low TRL of many new seismic technologies, traditional towed streamers are still considered as the main technology to measure, monitor and verify CCUS stores by operators”<sup>51</sup>*. Despite extensive studies and reviews conducted by bp and others (including by ETA for Project Vulcan and to produce the OREC/NZTC report commissioned by Orsted) and significant work undertaken by bp, no one has been able to come up with a replacement or alternative to using 3D towed streamer seismic (and subsequent time-lapse 4D seismic) as the monitoring method that would: (i) ensure repeatable imaging of the required level of resolution, and (ii) provide the necessary confidence concerning conformance and containment of the Endurance reservoir’s CO<sub>2</sub> plume.

### **3. SECTION 4 – “DIRECT PHYSICAL IMPACT DUE TO CO-LOCATION”**

3.1 Sub-section 4.1 of the OREC/NZTC report considers certain issues arising from helicopter operations occurring in a situation involving a co-located offshore windfarm and CCS project. bp recommends that section 7.1 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1, (electronic page numbers 175 – 188) and sections 7.8, 7.9 and 8.9 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2 (electronic page numbers 129 – 132) be read in conjunction with sub-section 4.1 of the OREC/NZTC report.

3.2 The OREC/NZTC report states that it has examined the potential for helicopter interactions from *“two perspectives”*, which are described as:

*“What the likely normal operating requirement will be for helicopter operations for CCUS projects;*

*and*

*What levels of access/clearance helicopters would need through an operational windfarm.”<sup>52</sup>*

3.3 In discussing helicopter interaction issues, the OREC/NZTC report does refer to the scenario of Hornsea 4 and Endurance co-locating. However, the report does not refer to or discuss sub-section 7.1 of the bp Technical Assessment which sets out detailed information concerning when, why and how helicopters will need to be able to gain access to the area where the Endurance store is located. Instead, the OREC/NZTC approaches the issue of helicopter access by making a number of assumptions about what will be needed. Unfortunately a number of the assumptions are incorrect. This means that although the content in sub-section 4.1 of the OREC/NZTC report may reflect discussions it held with various participants in the helicopter and drilling rig industries, the discussions and conclusions in Section 4 are of limited use for the purposes of NEP’s Endurance project.

3.4 Accordingly, whilst bp agrees with many of the considerations and concerns regarding helicopter access within wind farms that are discussed in sub-section 4 of the OREC/NZTC report:

3.4.1 bp does not agree with the report’s conclusion that providing an access corridor through the Hornsea 4 wind farm *“with a corridor width of approximately 2 km*

<sup>50</sup> [REP1-057](#), Appendix 1.1 (electronic page number 52)

<sup>51</sup> [REP1-057](#), Appendix 1.1 (electronic page number 52)

<sup>52</sup> [REP1-057](#), Appendix 1.1 (electronic page number 65)

*between turbines into the prevailing wind direction” and maintaining a 500m exclusion zone around each of the injection wells “to enable drilling rig operations”<sup>53</sup> would resolve all of the access related issues that would arise if there were turbines in the Exclusion Area; and*

- 3.4.2 bp continues to have the same concerns as set out in sub-section 7.1 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 175 – 188) and summarised in sections 7.8 – 7.9 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2 (electronic page numbers 129 – 130).
- 3.5 Given bp’s position has not changed, bp does not propose to set out here each of the problems created by the approach taken in sub-section 4.1 of the OREC/NZTC report. However, there are certain fundamental issues concerning the helicopter access problems that would arise with having wind turbines in the Exclusion Area which bp believes are approached in sub-section 4 in a way that gives rise to incorrect assumptions about what would, and would not, be needed in terms of helicopter access.
- 3.6 The first problem is how the OREC/NZTC report approaches the question of when helicopters would need to access Endurance for purposes of transferring/supporting personnel. Specifically, sub-section 4.1.1 of the report states that “...*Based on the above, there does not appear to be a case for the need for routine helicopter access to these potential future platforms. In the case of a medical emergency, the response time may actually be quicker with a walk-to-work vessel as it is on station at the platform during crew operations and would typically be equipped with an experienced medic...*”<sup>54</sup>. This statement is made after the report states that after the initial development, there could be “*several small platforms*” added for the purpose of treating the brine that may need to be released from the Endurance store. The report goes on to say that such platforms are likely to be fixed, normally unattended/unmanned installations (“NUIs”) that only need periodic visits for maintenance and possible operational issues.
- 3.7 The report is correct that generally NUIs require infrequent personnel visits. To that extent, bp agrees with the statement that there would be limited need for helicopter access to “*these future platforms*”.
- 3.8 bp’s concern is that the report goes on to say the following in sub-section 4.1.1:  
*“As with the initial development case, it is considered that there isn’t a strong case for the need for helicopter support during normal operations, even with the extended infrastructure that may be required for the Northern Endurance Partnership CCUS project in future.”<sup>55</sup>*
- 3.9 Whilst there may not be a need during the operational phase of the development to access any NUIs that may be installed for the purposes of treating brine, the statement above implies that these are the only “*extended infrastructure*” that might be required for the project, and therefore there will be very little need for any helicopter access during the “*normal*” operational phase. This is entirely incorrect. The Endurance development is phased, and as explained in the bp Technical Assessment and the bp Deadline 1 Submission<sup>56</sup>, not all of the injection wells will be drilled in the initial phase of the development, and a number will be drilled during the operational phase (with the exact location not being known until monitoring and other data and information is obtained and analysed).
- 3.10 This means that at various times during the operational phase, mobile drilling rigs will need to be used to drill injection wells. As discussed elsewhere in the OREC/NZTC report, the

<sup>53</sup> [REP1-057](#), Appendix 1.1 (electronic page number 73)

<sup>54</sup> [REP1-057](#), Appendix 1.1 (electronic page number 66)

<sup>55</sup> [REP1-057](#), Appendix 1.1 (electronic page number 66)

<sup>56</sup> See section 6.4 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 170 – 171) and sections 6, 7.8 and 7.9 of bp’s Deadline 1 Submission ([REP1-057](#), Appendix 2 (electronic page numbers 125 – 127 and 129))

type of mobile drilling rig used for Endurance is likely to be a jack-up rig. Those rigs will be located in the Overlap Zone and will have a permanent crew of 60 to 100 people. Depending on the operations involved, a rig may be on location in the Overlap Zone for up to a year, during which time helicopters will need to be able to access the rig. This differs from NUIs and means that the report’s statement that “... *there isn’t a strong case for the need for helicopter support during normal operations, even with the extended infrastructure that may be required for the Northern Endurance Partnership CCUS project in future*” is not correct. Helicopter access will be required during the operational phase of the project, and not simply for the purposes of responding to emergencies.

- 3.11 Similarly, to the extent that the following statement in sub-section 4.1 implies that there would not be a need for helicopter access to drilling rigs during the operational phase that is not accurate:

*“However, as mentioned previously, there doesn’t appear to be a strong operational case for regular helicopter access to any of the items of infrastructure associated with the planned Northern Endurance Partnership CCUS project, so restrictions on regular flight operations are not likely to be a consideration for this case.”<sup>57</sup>*

- 3.12 bp disagrees with the statement in sub-section 4.1.3 that there is a “...*lack of a strong operational case for regular helicopter support being required for CCUS operations relating to helicopter access...*”<sup>58</sup>. Whenever a rig is on location at Endurance, NEP is required to have safe and efficient rig operations, and for that to occur there need to be normal helicopter operations (under Commercial Air Transport rules) to carry out regular rig crew changes (typically between 10 and 15 passengers may be transported to and from a rig on operations every 2 to 3 days). In particular:

- 3.12.1 In saying that future brine treatment platforms could be NUIs, the report mentions the concept of “walk-to-work vessel transfers”. In essence, this involves using an extendable and wave-compensated access gangway between a transport vessel and a rig/platform. The report discusses this as a way to access possible future NUI brine treatment platforms without using a helicopter.
- 3.12.2 Walk-to-work transfers can be used for NUI operations. However, using a walk-to-work vessel transfer (rather than a helicopter) to access the elevated deck of a jack-up drilling rig would not be a routine operation. Additionally, a walk-to-work vessel transfer depends in part on relative movement of the vessel and the fixed rig/platform, and the relative movement is weather dependent. Drilling and workover operations from a rig require regular crew changes for personnel and trying to plan for that to coincide with the movements of transfer vessels would be challenging, particularly in bad weather.
- 3.12.3 An infill drilling campaign (for example drilling additional CO<sub>2</sub> injection wells) or brine production well campaign could involve having a rig on location or multiple locations in the Endurance storage site for up to a year. With 60 to 100 people on board, using commercial air transport for crew change operations is the only practical and efficient solution for staggered crew changes that happen every 2 weeks.
- 3.12.4 In terms of other theoretical ways to transfer crew to rigs without using helicopters, in the past cranes at times were used to carry out transfers by personnel basket or other types of personnel carriers. bp has experience with this form of transfer happening in offshore regions. However, they are subject to more onerous vessel and weather constraints than walk-to-work vessel transfer,

<sup>57</sup> [REP1-057](#), Appendix 1.1 (electronic page number 68)

<sup>58</sup> [REP1-057](#), Appendix 1.1 (electronic page number 69)

and in the North Sea transfers by crane and personnel carriers have, for safety reasons, effectively been eliminated for routine operations.

- 3.12.5 Medevac flights for illness or accidents (rather than emergency evacuations) currently fall under Commercial Air Transport (CAT) rules, not Search and Rescue (SAR). The capability to medevac personnel usually forms part of a rig's safety case and means regular commercial helicopters can be called upon to evacuate personnel from a rig. As explained in paragraph 7.9.2 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2 (electronic page number 129) (i) the Civil Aviation Authority's maritime standards dictate that in order for flights to occur, minimum safe distances (corridors) must exist between wind turbines; and (ii) even if the amount of helicopter access was limited by using marine vessels to transfer crew, the same required corridors between the wind turbines would need to exist in order to allow helicopter access for rapid evacuation of personnel in an emergency situation and for SAR.
- 3.12.6 Although loss of containment of CO<sub>2</sub> is low probability, if it occurred and required drilling of a relief well, a drilling rig would need to be rapidly deployed to the Endurance field and drilling a relief well would require regular crew change flights and also the potential for helicopter freight operations. NEP is required to at all times have the ability to respond to loss of containment of CO<sub>2</sub> and carry out relief well work, which means helicopters must always be able to access Endurance at short notice, which in turn requires that access corridors always exist.

#### **Sub-Section 4.2 – “Drilling Rig Access”**

- 3.13 Sub-section 4.2 of the OREC/NZTC report discusses the access to Endurance that will be needed for drilling rigs. bp recommends that section 7.1 of the bp Technical Assessment ([REP1-057](#), Appendix 2, Annex 1 (electronic page numbers 175 – 188) and sections 7.8 and 7.9 of the bp Deadline 1 Submission ([REP1-057](#), Appendix 2, pages 15 – 16 (electronic page numbers 129 – 130)) be read in conjunction with sub-section 4.2 of the OREC/NZTC report.
- 3.14 bp agrees with the OREC/NZTC report's conclusion that:
 

*“Taking all of the above information into account, it is evident that a clear pathway to enable drilling rig access will be required at all stages of the CCUS project's lifecycle ...”*<sup>59</sup>
- 3.15 In terms of the amount of drilling rig access required during the various stages of the development, bp notes the following:
  - 3.15.1 bp has already had several engagements with Valaris (the drilling rig contractor that was consulted by the ETA in preparing the OREC/NZTC report) over the past two years to discuss rig towing and positioning within a windfarm, and in fact NEP provided to Valaris the drawing used in Fig 18 of the OREC/NZTC report to illustrate potential pathways for this purpose.
  - 3.15.2 As noted on page 41 of the OREC/NZTC report, “*an amount of well workover activities*”<sup>60</sup> will be needed during the life of the NEP project. Given the First of a Kind (FOAK) nature of the NEP project and novel well operation, currently the planned rig based well workover frequency is one workover occurring every 5 years and being of 40-day duration. These well workovers will require a drilling

<sup>59</sup> [REP1-057](#), Appendix 1.1 (electronic page number 71)

<sup>60</sup> [REP1-057](#), Appendix 1.1 (electronic page number 71)

rig as a light well intervention vessel (LWIV) is not suitable for these workover operations because LWIV vessels cannot pull the heavy tubing from a well.

- 3.15.3 In discussing the need for rigs to access Endurance during the operational phase, page 41 of the OREC/NZTC report states that: “... *the probability of the need for intervention wells to “correct” leaks from an operational injection will be very low.*” In making this assessment, the report refers to Endurance being a FOAK project in the UK, with a lot of “*focus from government over the completion design of the wells, which will likely lead to them being designed to be “best-in-class”.*” Whilst the wells will indeed be designed to “best-in-class” standards, this:
- (A) would happen irrespective of this being a FOAK project or attracting government attention;
  - (B) has little bearing on the frequency of the need for intervention wells as they are required not primarily for minor repair such as correcting leaks. Instead intervention wells are mainly used for surveillance and monitoring purposes as will be defined in the MMV that forms part of the Endurance store permit application and will be subject to approval by the regulator (NSTA). LWIV visits are planned for these in-well surveillance operations on a 5-yearly cycle, with each campaign requiring the LWIV to be in-field for up to 55 days (during which time they will require helicopter access for crew changes).
- 3.16 In addition to the activities identified on pages 39-41 of the OREC/NZTC report and the other surveillance/work involving vessels that is described above, injection wells are expected to require “water washing”<sup>61</sup> to dissolve halite (salt) – this is planned to be carried out from a vessel on a yearly cycle with a 17-day campaign per visit to cover the five CO<sub>2</sub> injection wells.
- 3.17 As explained above in paragraph 3.12.6, although loss of containment of CO<sub>2</sub> is a low probability, NEP is required to at all times have the ability to respond to loss of containment of CO<sub>2</sub> on an existing injection well in the fields and to carry out relief well work. This means that drilling rig access is required at all times in case a relief well is required. Relief well operational envelope considerations have been provided for development wells based on the current NEP project development. If rig access is inhibited by the presence of wind turbines, extended wells may need to be drilled outside the safe technical drilling envelope. This could risk failure of any relief well operation, prolonged CO<sub>2</sub> leakage and shutdown of all CO<sub>2</sub> injection operations. As previously noted, there will always need to be helicopter access to a rig on relief well duty (rapid and timely personnel and equipment transportation is essential). Similarly, there will always be a need for a rig to be able to access Endurance for relief well purposes.
- 3.18 bp agrees with the recommendation in sub-section 4.2.3 of the OREC/NZTC report that “*an access corridor be provided through the Hornsea 4 wind farm*”<sup>62</sup>, However, bp believes that: (i) these corridors need to be provided for *all* potential surface locations required to access subsurface targets for *both rigs and helicopter access*; and (ii) the dimensions of the corridors need to be designed in consultation with helicopter operators, rig contractors, bp, Orsted and other stakeholders.

#### 4. **SUB-SECTION 5 – “INFRASTRUCTURE BLOCKING SEABED ACCESS”**

- 4.1 Section 5 of the OREC/NZTC report discusses “*the risk of existing Offshore Wind (OW) or CCUS physical infrastructure limiting access for other parties in the same area*”<sup>63</sup> The

<sup>61</sup> This operation involves injecting fresh or low-salinity water into the reservoir from the well head.

<sup>62</sup> [REP1-057](#), Appendix 1.1 (electronic page number 73)

<sup>63</sup> [REP1-057](#), Appendix 1.1 (electronic page number 76)

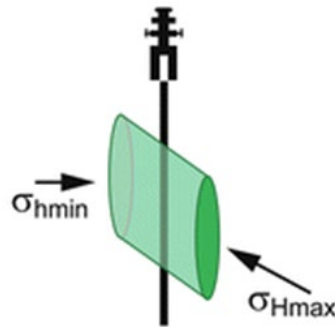
report: (i) notes that the CCUS project's injector and observation wells are one of the main areas where the wind farm's access to the seabed may be physically blocked; and (ii) assesses whether there is "flexibility" in the placement of the wells.

- 4.2 bp has reviewed the various well design options discussed in Section 5 of the OREC/NZTC report.
- 4.3 The 45 degree and 19-degree profiles (Options 1 and 2) are technically feasible from the perspective of simply looking at a well design from a theoretical design perspective.
- 4.4 The OREC/NZTC report, however, recognises that well design is not just a theoretical exercise and that various factors affect the design:
 

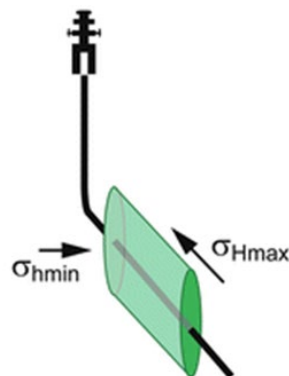
*"The same base directional design assumptions have been applied to each well. It should be noted that, in practice, these will differ depending on the seabed locations and targets."*<sup>64</sup>
- 4.5 Notwithstanding that recognition, the discussion of the Options in Section 5 of the OREC/NZTC report fails to take account of various factors that are relevant to designing wells for the purposes of developing Endurance. One important factor involves maximising the integrity of the CO<sub>2</sub> injection wells, and one way of doing this is to minimise the chances of any cement defects occurring. This is one of the reasons why vertical wells (and not deviated wells) are the preferred type of injection well for the development of Endurance.
- 4.6 Another important factor that is not considered in Section 5 of the OREC/NZTC report is that in the future brine production wells may be required to bleed off reservoir pressure as CO<sub>2</sub> is injected. Maximising the flow rate (productivity) of brine from these wells is key to reducing the number of brine production wells that may need to be installed (and in turn impact on surrounding infrastructure). This may require a hydraulically-stimulated completion technique which in turn requires that the well is orientated relative to (or in the case of a vertical well is independent of) the rock stresses underground.
- 4.7 These considerations are explained below in more technical detail.
- 4.8 Given the diversity of the ECC emitters whose CO<sub>2</sub> will be injected in Endurance, a key requirement of the wells is that they can cope with dispatchable/non-constant and fluctuating CO<sub>2</sub> flow rates. This means that the wells may be subject to frequent and regular shut-ins and start-ups, which subjects the wells to pressure and thermal stress and fatigue loads.
- 4.9 To cope with these loads, the cement slurry will be made denser than would conventionally be used to achieve higher compressive strength. This has a knock-on effect on equivalent circulating density (ECDs) which limits the step-out.
- 4.10 As integrity and CO<sub>2</sub> resistance is key, the more vertical a well is, the less risk of channelling or other cement defects there is.
- 4.11 Step out may be further limited by the desire to put the downhole safety valve (SSSV) as vertical as possible, which pushes the kick-off point deeper.
- 4.12 For brine wells, it is likely that a hydraulically-stimulated completion will be required to achieve sufficient rate – this drives a near-vertical profile though the reservoir to be independent of the minimum overburden stress direction. These completions provide an increased surface area for flow, creating a negative skin (increase in effective permeability); however, the orientation of fracture propagation relative to the well bore trajectory is dependent upon the orientation of the in-situ minimum and maximum stress

<sup>64</sup> [REP1-057](#), Appendix 1.1 (electronic page number 77)

field. Fracture propagation needs to be near perpendicular to the wellbore which is more difficult to achieve with a deviated well especially if the surface location is subject to constraint relative to the target. This drives the need for a vertical to near vertical well path through the reservoir.

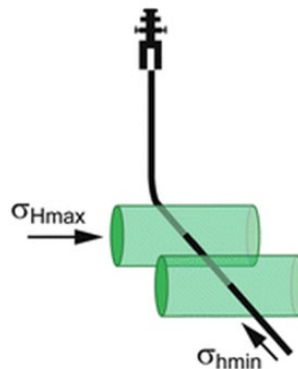


**Figure 2** A vertical well is ideal as it will develop a fracture orthogonal to the wellbore no matter what the direction of minimum horizontal stress



**Figure 3** A deviated well trajectory should be at right angles to the direction of minimum horizontal stress to develop a productive fracture feature. Both surface and target locations must be known and be able to be positioned to develop the trajectory required. Even in an ideal environment, this can be difficult to achieve in practice





**Figure 4** If a deviated well is not aligned across the minimum horizontal stress direction along its length, multiple small fractures may develop (2 shown here) which may not provide any increase in effective flow area as the fractures meet the wellbore at a series of small surface area intersections

4.13 Page 54 of the OREC/NZTC report recommends that Orsted “*consider Option 2 ... to be the maximum practical offset for a deviated well within the Northern Endurance Partnership CCUS project*”<sup>65</sup>. However, as explained above, the injector wells are, in fact, planned to be vertical wells and not deviated wells.

## 5. SECTION 6 – “CONCLUSIONS”

5.1 bp and Orsted have, during the last few years, spent significant time engaging with each other and other stakeholders to determine whether Hornsea Project 4 wind farm and NEP’s Endurance project can co-exist in the entirety of the Overlap Zone. bp has been supportive of all of the various studies and work that has been undertaken concerning these matters.

### MMV Survey Interaction

5.2 bp has carefully considered the analysis, suggestions, and recommendations in the OREC/NZTC report. In a number of respects the conclusions of the report’s analysis of potential means of carrying out MMV are consistent with bp’s assessment of what is (and is not) feasible in terms of monitoring options for the Endurance project. In particular:

5.2.1 the OREC/NZTC report recognises towed streamer and OBN as the technologies most appropriate for MMV in respect of CO<sub>2</sub> injection:

*“Reflection seismic (towed streamer or ocean bottom nodes) in the form of 3D acquisition for time lapse studies is currently viewed as the most applicable and mature technology to monitor the impact of CO<sub>2</sub> injection on plume migration and assessment of store integrity.”*<sup>66</sup>

5.2.2 having recognised towed streamer and OBN to be the most appropriate means of carrying out MMV for CO<sub>2</sub> injection, the OREC/NZTC report does not go on to assess towed streamer and OBN acquisition in the specific context of the Endurance project, and the report does not make a recommendation as to which of these the authors consider would be appropriate for the Endurance project. Instead, the report notes that the spacing and layout of wind turbines create challenges for acquiring towed streamer acquisition and that the spacing of the

<sup>65</sup> [REP1-057](#), Appendix 1.1 (electronic page number 84)

<sup>66</sup> [REP1-057](#), Appendix 1.1 (electronic page number 88)

OBNs can significantly affect the image. The report also notes the high cost of using OBNs to acquire seismic data. bp agrees with these observations.

- 5.2.3 as explained above and in the bp Technical Assessment, bp's conclusion that OBN cannot be used for the Endurance project is not because it costs more than towed streamers. The problem with using OBNs for Endurance is the shallow water, sand waves and strong tidal currents. The OREC/NZTC report does not consider this issue.
- 5.2.4 having extensively studied and considered alternatives to 3D towed streamer and OBNs, bp concluded no alternative means of carrying out MMV were appropriate for NEP's project. This is consistent with the OREC/NZTC report which recognises that alternatives to seismic acquisition and emerging technologies are not appropriate for monitoring injected CO<sub>2</sub>:
- “Alternatives to seismic acquisition were also examined but these techniques like control source electromagnetism, distributed acoustic sensing, and gravity monitoring were either deemed to be inappropriate or were emerging technologies at a lower TRL which could be used to compliment seismic rather than replace it.”<sup>67</sup>*
- 5.2.5 similarly, the ETA did not suggest that any of the various new processing techniques currently being researched (e.g., mirror imaging, compressive sensing), or permanent or passive arrays, were suitable for the purposes of the MMV of injected CO<sub>2</sub>. bp agrees with this assessment.
- 5.3 Accordingly, nothing in the OREC/NZTC report challenges or is inconsistent with bp's conclusions that:
- 5.3.1 the sand waves and tidal currents in the location of the Endurance reservoir would degrade the quality of imaging from OBN;
- 5.3.2 in comparison to proven towed streamer seismic, no feasible alternative monitoring solution is deployable today, which provides the reliable 4D imaging of the store and overburden required to ensure containment and covers all eventualities of required monitoring, such as complex migration pathways and non-conformance of the CO<sub>2</sub> migration; and
- 5.3.3 the presence of wind turbines in the Exclusion Area will prohibit the use of towed streamer acquisition.
- 5.4 The OREC/NZTC report includes a “*conceptual view*” on a MMV strategy that is based on a combination of existing technologies and “*those potentially available in the future*”<sup>68</sup> and hence theoretical in nature. The OREC/NZTC report recognises that what it proposes does not offer a solution to the challenges currently facing co-location of a wind farm and CCS/CCUS project. The report also recognises that even its suggestion that using a “*standard minimum square grid formation of one turbine every 2 km*”<sup>69</sup> whilst further studies

<sup>67</sup> [REP1-057](#), Appendix 1.1 (electronic page number 88)

<sup>68</sup> [REP1-057](#), Appendix 1.1 (electronic page number 89)

<sup>69</sup> As explained above (paragraph 2.28), bp does not agree that towed streamer seismic could be implemented if turbines were placed in a 2kmx2km grid pattern. bp's analysis of minimum streamer length is 1.5km, which requires a 1km safety margin from turbines, and a 2km spacing would only allow for a single 2D line every 2km. This is a very sparse 2D survey that would not provide confidence in containment of CO<sub>2</sub> and would not provide the necessary imaging of the CO<sub>2</sub> in the store to assess conformance.

are undertaken would not offer a solution as it also is only theoretical and subject to further investigation:

*“Although the report provides context and answers to many of the original questions, the ETA has concluded that while there is information available on the individual aspects of CCUS and Offshore Wind there is a lack of literature on, and understanding of, the impact of co-locating projects. This is specifically around the impact of turbine layout and noise on MMV activities and how to monitor plume development away from wells. Further studies are required before a definitive conclusion can be made. Until these issues have been addressed, a standard minimum square grid formation of one turbine every 2 km would need to be implemented. This relates to around nine diameters of the proposed turbines and would allow for rig access and opens the potential to use towed streamer acquisition for monitoring storage conformance and CO2 plume development away from wells. This would be unless the cost of Ocean Bottom Node technology could be justified/reduced or a series of other MMV technologies can be compiled to provide full coverage. This layout would need to be investigated by the wind and CCUS operator to identify if this is feasible and economical for the project to continue.”<sup>70</sup> (emphasis added)*

- 5.5 Accordingly, the OREC/NZTC report does not conclude or state that, in fact, it is possible for Hornsea 4 wind turbines and Endurance to co-exist in the entirety of the Overlap Zone.

#### Direct Physical Impact due to Co-Location

- 5.6 For reasons explained above<sup>71</sup>, bp does not agree with the ETA’s suggestion in Section 4 of its report that the need to have helicopter access to Endurance would be “*minimal*” during the operational phase of the project. This incorrect assumption also appears in sub-section 6.2 of the report. In fact, commercial crew change and ad-hoc helicopter flights are required for safe and efficient operations any time a drilling or workover rig is on location in the Endurance field, both for servicing and repair of existing and future wells. Even if the frequency of demand can be significantly reduced, the fact that the demand cannot be completely eliminated means helicopter access will still need to be provided for and maintained throughout the life of the operations at Endurance.
- 5.7 It is suggested in sub-section 6.2 of the OREC/NZTC report that “*2 km corridors should be incorporated into the design of the wind farm to allow for drilling access.*”<sup>72</sup> This would by design effectively eliminate the ability to access a rig with a helicopter for all bar Coastguard / SAR flights, compromising safety and the ability to operate efficiently and in a timely manner. The operational needs of NEP’s project include using vessels to maintain existing wells and using drilling rigs for the additional injection wells whose exact location cannot be determined until the initial injection of CO<sub>2</sub> occurs and information is available concerning how and where the injected CO<sub>2</sub> migrates. Accordingly, regular commercial helicopter services will be needed at Endurance and that would not be possible with wind turbines in the Exclusion Area and 2km corridors for helicopter access.

#### Infrastructure Blocking Seabed Access

- 5.8 The recommendation in sub-section 6.3 of the OREC/NZTC report concerning the best well design option is based on the ETA considering possible well designs in isolation and the ETA did not consider the specific operating requirements that will, due to unique aspects of the NEP project, be applicable to the injection wells at Endurance. Those additional operating requirements indicate vertical wells (and not deviated wells) are required to ensure well integrity. For example, there will need to be dispatchable operations, which means that wells will be shut-in and opened up on a regular and frequent basis. This

<sup>70</sup> [REP1-057](#), Appendix 1.1 (electronic page number 88)

<sup>71</sup> Paragraphs 3.1 – 3.12

<sup>72</sup> [REP1-057](#), Appendix 1.1 (electronic page number 90 – 91)

requires additional cement strength and pumping this cement into the well to provide integrity and isolation for the CO<sub>2</sub> when the well is constructed invites more risk of defects when well deviation angle increases (step-out away from the seabed drilling location).

## 6. CONCLUSION

- 6.1 bp has carefully considered the analysis, suggestions and recommendations in the OREC/NZTC report prepared on behalf of Orsted.
- 6.2 Whilst the OREC/NZTC report does not refer to or address the content of bp's own Technical Assessment (which appears not to have been provided to its authors), much of its analysis is consistent with and complementary to bp's position. The OREC/NZTC report does not conclude that co-location across the entirety of the Overlap Zone is, in fact, feasible. Indeed, none of the expert analysis that has so far been put before the ExA would support such a conclusion, and the authors of the OREC/NZTC report are careful not to suggest that they have identified a solution to the serious obstacles that are acknowledged to exist.
- 6.3 bp has identified several important limitations in the scope and content of the OREC/NZTC report, which must be taken into account when assessing its contents and determining what weight can be given to its analysis.
- 6.4 Where there are material differences in the assessments undertaken by bp and OREC/NZTC on behalf of Orsted, this response explains why bp's assessment is more complete, up-to-date and robust, and is therefore to be preferred.
- 6.5 For those reasons the OREC/NZTC report does not alter bp's position as to the potential for the two projects to co-exist within the entirety of the Overlap Zone, or as to the provision that should be made within the DCO in order to address this.

**APPENDIX 2**

**THE INTERFACE AGREEMENT DATED 14 FEBRUARY 2013**

Dated 14 February 2013

THE CROWN ESTATE COMMISSIONERS (1)  
and  
NATIONAL GRID TWENTY NINE LIMITED (2)  
and  
SMART WIND LIMITED (3)

## INTERFACE AGREEMENT

relating to an Overlap Zone

Linklaters

Linklaters LLP  
One Silk Street  
London EC2Y 8HQ

Telephone(+44) 20 7456 2000  
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Refmbsmith

**BETWEEN:**

- (1) **THE CROWN ESTATE COMMISSIONERS** on behalf of Her Majesty The Queen acting in exercise of the powers of the Crown Estate Act 1961 (the "**Commissioners**"); and
- (2) **NATIONAL GRID TWENTY NINE LIMITED** (Company No 08116471) a company incorporated in and existing under the laws of England having its registered office at 1 - 3 Strand, London WC2N 5EH; and
- (3) **SMART WIND LIMITED** (Company No 07107382) a company incorporated in and existing under the laws of England having its registered office at 11th Floor, 140 London Wall, London, EC2Y 5DN.

**WHEREAS**

- (A) The Commissioners have entered into the ZDA with Smart Wind Limited in respect of Zone 4.
- (B) On or about the date of this Agreement the Commissioners have entered into the Carbon AfL with National Grid Twenty-Nine Limited in respect of the Lease Option Area.
- (C) As Zone 4 and the Lease Option Area overlap, the Parties have agreed to entered into this Agreement to regulate and co-ordinate their activities within the Overlap Zone with a view to managing potential conflicts and resolving actual conflicts

**NOW IT IS HEREBY AGREED** as follows:

**1 Interpretation and Definitions**

In this Agreement unless the context otherwise requires:

- 1.1.1 words importing one gender include other genders;
- 1.1.2 words importing the singular include the plural and vice versa;
- 1.1.3 references to persons include bodies corporate and vice versa;
- 1.1.4 references to clauses, schedules and annexures are references to the relevant clauses in or schedules or annexures to this Agreement and references to paragraphs are to the relevant paragraphs in schedules to this Agreement;
- 1.1.5 the clause headings do not affect the construction of this Agreement;
- 1.1.6 reference to any statute, directive or regulation or other item of legislation includes any amendment, modification, extension, consolidation or re-enactment of it and includes any statutory instrument, regulation or order made under it for the time being in force;
- 1.1.7 any obligation on any Entity not to do or omit to do something shall be construed as including an obligation not to permit or knowingly to suffer it to be done by any other person;
- 1.1.8 references to the Commissioners where the context admits includes their successors or assigns;

1.1.9 a consent or approval to be given by the Commissioners is not effective for the purposes of this Agreement unless it is in writing and signed by or on behalf of the Commissioners; and

1.1.10 references to the word “include” or “including” shall be construed without limitation.

1.2 Any covenant by (or implied to be made by) Her Majesty pursuant to the terms of this Agreement is made (or implied to be made) by the Commissioners acting in exercise of the powers conferred by the Crown Estate Act 1961. No covenants, agreements or obligations are given by Her Majesty or anyone who reigns after Her. No liability is imposed on Her Majesty or anyone who reigns after Her nor on the Commissioners in any personal or private capacity.

1.3 In this Agreement, unless the context otherwise requires, the following expressions shall have the following meanings:

“**Activities**” means those activities that either Entity plans to undertake within the Overlap Zone (including without limitation design, surveys, construction, installation, drilling, operation and maintenance), or outside the boundary of the Overlap Zone but with a direct impact on the location of Proposed Infrastructure within the Overlap Zone or seismic surveys outside the boundary of the Overlap Zone but with a direct impact on the carrying out of the other’s Activities within the Overlap Zone;

“**Affected Entity**” means the Entity to which the Notifying Entity gives notice;

“**Affiliate**” means, in relation to any person, any holding company or subsidiary of that person or any subsidiary of such holding company, and “**holding company**” and “**subsidiary**” shall have the meaning given to them in section 1159 of the Companies Act 2006;

“**Baseline**” means, at any point during the term of this Agreement, the Proposed Infrastructure locations and the Programme of Activities notified by an Entity to the other Entity pursuant to the terms of this Agreement;

“**Carbon AfL**” means an agreement for lease of the Overlap Zone (with other areas) made between the Commissioners and the Carbon Entity on or about the date of this Agreement;

“**Carbon Entity**” means National Grid Twenty Nine Limited being the tenant for the time being under the Carbon AfL or Carbon Lease, as applicable;

“**Carbon Lease**” means a lease of rights including any part of the Overlap Zone to be granted to the Carbon Entity by the Commissioners pursuant to the Carbon AfL;

“**Claims Settlement Date**” means 31 January in any year;

“**Consultation Process**” means the consultation processes undertaken by or on behalf of an Entity in respect of its project as required by any applicable law and/or regulation but excluding any bilateral consultations between the Entity and a particular individual or organisation;

“**Commercial Operation Date**” means in respect of the Wind Lease, the date that the Wind Entity achieves the satisfactory completion of such procedures and tests as from time to time constitute usual industry standards and practices to demonstrate that all of the wind turbines have been fully commissioned and that all relevant tests have been carried out such that each of the wind turbines is capable of commercial operation and exporting



electricity via the connection point and in respect of the Carbon Lease, the date of Mechanical Completion;

**“Demonstrably”** means supported by evidence;

**“Entity”** means the Carbon Entity or the Wind Entity as appropriate and **“Entities”** means both of them;

**“Good Industry Practice”** shall, in the case of the Carbon Entity, have the meaning given to it in the Carbon AfL and shall, in the case of the Wind Entity, mean acting as a Reasonable and Prudent Operator as such term is defined in the ZDA;

**“Interface Management Meetings”** has the meaning given to the term in Clause 3.4;

**“Lease Option Area”** shall have the meaning given to it in the Carbon AfL of which the co-ordinates are set out in Part 1 of Schedule 1 and shown for identification purposes only edged red on the Plan;

**“Material Adverse Effect”** means Material Adverse Effect (Pre-Operational) or Material Adverse Effect (Post-Operational), as applicable;

**“Material Adverse Effect (Post-Operational)”** in relation to any proposed Activities means in relation to Carbon Entity's proposed Activities, Demonstrably requiring any of the Wind Entity's operational projects to reduce their power output for a period of time or in relation to Wind Entity's proposed Activities, Demonstrably requiring any of the Carbon Entity's operational projects to reduce their carbon injection or storage activities for a period of time;

**“Material Adverse Effect (Pre-Operational)”** in relation to any proposed Activities means Demonstrably giving rise to Relocation Costs and/or Re-programming Costs;

**“Mechanical Completion”** means the technical completion of the construction and integration of the physical systems of the integrated systems for carbon capture and compression, transport (including any pipelines), injection and permanent storage facilities has occurred;

**“Necessary Consents”** shall, in the case of the Wind Entity, have the meaning given to it in the ZDA and, in the case of the Carbon Entity, have the meaning given to it in the Carbon AfL;

**“Notifying Entity”** means the Entity so identified and defined for the purposes of Clause 3.2, 3.4 or 4.5, as the context shall require;

**“New Entity”** means an Entity which is not a party to this Agreement on the date it is entered into but becomes a party by virtue of the operation of Clause 8;

**“Overlap Zone”** means the area within which the Lease Option Area and Zone 4 overlap of which the co-ordinates are set out in Part 3 of Schedule 1 and shown for identification purposes only tinted pink and hatched blue on the Plan;

**“Party”** means any party to this Agreement including any New Entity that enters into a deed of covenant pursuant to Clause 8 and **“Parties”** shall be construed accordingly;

**“Plan”** means the plan annexed to this Agreement at Schedule 2;

**“Programme of Activities”** means the timetable of Activities which an Entity plans to carry out in relation to its project setting out the dates on which, and coordinates for where,

such Activities are planned to take place and sufficient details of the Activities for the other Entity to assess the impact on its Activities;

**“Proposed Infrastructure”** means any infrastructure that either Entity proposes to install for the purposes of developing an operational project on, over or immediately under the Overlap Zone including without limitation (in the case of the Wind Entity) cables, anemometry masts, sub-stations and wind turbines or (in the case of the Carbon Entity) the Carbon Storage Infrastructure (as such term is defined in the Storage AfL and includes, for the avoidance of doubt, any in field pipelines;

**“Relevant Agreement”** means the ZDA, any Wind AfL, the Carbon AfL, any Wind Lease and/or the Carbon Lease, as appropriate;

**“Relocation Costs”** means:

(a) the additional costs and/or expenses that are or would be incurred by the Affected Entity (including without limitation reasonable third party consultancy and contractor fees in modifying plans, carrying out any additional or amended surveys and implementing such modified plans and any costs) to accommodate the Notifying Entity’s notified Activities; and

(b) where any part of an Entity’s Proposed Infrastructure for a particular project as shown on any plan provided by that Entity to the other prior to the other’s notice of its proposed Activities (in the case of the Wind Entity, the number of turbine locations being Demonstrably consistent with Good Industry Practice at the time of notification by the Wind Entity for comparable offshore wind projects):

- (i) cannot reasonably and commercially be re-located within the relevant project site to enable the other’s Activities to be undertaken; or
- (ii) can reasonably and commercially be re-located within the project site to enable the other’s Activities to be undertaken but with the result that (a) (in the case of the Wind Entity) the power output for the Wind Entity’s project will be lower than would otherwise have been the case; or (b) (in the case of the Carbon Entity) the injection rate or storage capacity for the Carbon Entity’s project will be Demonstrably lower than would otherwise have been the case,

then

- (1) in the case of the Wind Entity, the diminution in the market value of the Wind Entity’s project that will arise due to the loss of such infrastructure or reduction in power output as the case may be, such diminution being calculated at the time of: (i) the Carbon Entity’s notice of its proposed Activities; or (ii) the date of grant of the relevant Wind Lease, whichever is the later. Where (ii) applies, such calculation and assessment of impact shall take into account the difference between the number of turbines on the plan provided by the Wind Entity as referred to in (b) above and the number of turbines proposed at the date of grant of the relevant Wind Lease including any proposed changes to the array and sizes of the turbines such difference shall not be definitive and the arrays must be Demonstrably consistent with Good Industry Practice for comparable constructed offshore wind projects; and
- (2) in the case of the Carbon Entity, the diminution in the market value of the Carbon Entity’s project that will arise due to the loss of such infrastructure or reduction in storage rate or volume as the case may be, such diminution being calculated at the

time of the Wind Entity's notice of its proposed Activities or the date of grant of the relevant Carbon Lease whichever is the later;

**"Re-programming Costs"** means the additional costs and/or expenses that would be incurred directly by either Entity (including reasonable third party consultancy and contractor fees) in modifying and then implementing such modified development, construction or maintenance programme including, without limitation such costs and/or expenses incurred in amending any application for any Necessary Consent and/or to make required consequential modifications to existing Necessary Consents and/or arising as a result of any reduction in or restriction in availability of any financial support mechanism available to that Entity's offshore project(s) as a result of any delay;

**"Wind Entity"** means Smart Wind Limited and/or any Project Company (as defined in the ZDA) established to develop projects in the Overlap Zone and any project company established to develop the grid assets in relation to the Overlap Zone including any licensed offshore transmission owner together in each case with their successors and assigns and any reference to Wind Entity shall mean any one or more of them;

**"Wind AfL"** means any agreement for lease granted by the Commissioners in respect of any part of the Overlap Zone in accordance with the ZDA;

**"Wind Lease"** means any lease granted by the Commissioners in respect of any part of the Overlap Zone in accordance with the ZDA and a Wind AfL;

**"ZDA"** means the zone development agreement entered into between the Commissioners and Smart Wind Limited on 22 December 2009 in respect of Zone 4 in the form in effect on the date of this Agreement; and

**"Zone 4"** means the offshore wind Round 3 Zone 4 (North Sea off Hornsea) as denoted by the coordinates in Part 2 of Schedule 1 and the relevant part of which is shown for identification purposes only edged and hatched blue on the Plan.

## **2 Commissioners' consent for location of Proposed Infrastructure and Entities' notifications of Programmes of Activities**

**2.1** The intent of this Agreement is to provide a mechanism to seek to ensure successful co-existence of wind and carbon storage projects on an overlapping area of the seabed, and to provide sufficient certainty to the Entities to be able to plan and implement their respective projects. The provisions for Commissioners' approval, Expert determination (as set out in Clause 6) and compensation specified herein are intended to provide a framework within which both the Carbon Entity and the Wind Entity are incentivised to work together and to plan their activities to give each other sufficient certainty to progress their respective projects. The Parties shall carry out their obligations, and exercise their rights, under this Agreement and (to the extent relevant for the operation of this Agreement) the Relevant Agreements in good faith and in a manner that does not unduly hinder the timely progress and development of wind or carbon storage projects in the Overlap Zone. Where a Material Adverse Effect has arisen, the Entities shall mitigate, to the extent reasonably practicable, the impact of such Material Adverse Effect on itself or the other Entity.

**2.2** Each Entity shall consult early and fully with the other as part of any Consultation Processes it is conducting for the purpose of applying for and procuring any Necessary Consents, including without limitation under the Energy Acts 2004 and 2008, Petroleum Act 1998, Planning Acts, under the requirements of Petroleum Operation Notices, during the

production of Environmental Statements, and during the production of any development consent application. Each Entity agrees that it shall not lodge any objection or make any representation to any application of the other Entity for a Necessary Consent where such Necessary Consent is in relation to projects sited within the Overlap Zone.

**2.3** The Entities further agree that they shall act in good faith in seeking to negotiate any Crossing Agreements required to facilitate each Entity's projects and that the principles set out in Schedule 3 to this Agreement shall be incorporated in any such Crossing Agreement.

**2.4** The Entities acknowledge and accept that:

**2.4.1** until an Entity has submitted for approval to the Commissioners under the Relevant Agreement details of its Proposed Infrastructure, the Commissioners may approve the siting of the other Entity's Proposed Infrastructure within the Overlap Zone; and

**2.4.2** the Commissioners have the right to withhold consent under the Relevant Agreement to the siting within the Overlap Zone of either Entity's Proposed Infrastructure. The Commissioners have the right to withhold consent if such siting would conflict with a use which is existing at the time of such submission, or where it has already approved the siting of the other Entity's Proposed Infrastructure or Activities in, or within a significantly close distance from, the location of such Proposed Infrastructure until such time as the Entities have reached commercial agreement or the matter has been determined in accordance with the terms of this Agreement.

**2.5** Where the Entities have reached commercial agreement in relation to any changes to either of their respective Activities pursuant to this Agreement and/or any compensation that may be payable, the terms of such commercial agreement will be documented in writing in an agreement between them, and the Commissioners shall withhold consent under the Relevant Agreement until such time as such agreement has been validly executed by each of the Entities and a copy provided to the Commissioners.

**2.6** Where the Expert has made a determination pursuant to this Agreement the following provisions shall apply:

**2.6.1** the Commissioners shall withhold consent under the Relevant Agreement to any proposed locations of Proposed Infrastructure which are the subject matter of the determination until:

- (i) the Notifying Entity has accepted such determination and provided for any compensation determined in accordance with this Clause 2; and/or
- (ii) where the determination requires amendment to either or both of the Entities' Activities and/or the location of an Entity's Proposed Infrastructure such amendment to reflect the determination has been agreed in writing between the Entities, which in such circumstances each Entity agrees to act reasonably in documenting such amendment; or
- (iii) the Notifying Entity notifies the Commissioners that it does not intend to proceed with the locations of Proposed Infrastructure in accordance with Clause 2.6.3.

**2.6.2** Where the determination relates to a Material Adverse Effect arising from a notified Programme of Activities, the Notifying Entity shall not proceed to implement the

notified Programme of Activities or notified changes to the Programme of Activities (as applicable) until:

- (i) the Notifying Entity has accepted such determination and provided for any compensation determined in accordance with this Clause 2; and/or
- (ii) where the determination requires amendment to either or both of the Entities' Activities and/or the location of an Entity's Proposed Infrastructure such amendment to reflect the determination has been agreed in writing between the Entities, and in such circumstances each Entity agrees to act reasonably in documenting such amendment.

**2.6.3** If either Entity, acting reasonably, believes that the impact of the determination would be to make its project no longer commercially or technically viable, it may elect not to accept such determination and may reassess its proposed Activities accordingly or by notice terminate the Relevant Agreement.

**2.7** Where compensation from a Notifying Entity to an Affected Entity is to be agreed or determined in relation to a Material Adverse Effect, or where an estimate of such compensation is to be agreed or determined for reassessment at a later date in the case of compensation falling within limb (b) of the definition of Relocation Costs of the affected Entity, then:

**2.7.1** except in relation to compensation falling within limb (b) of the definition of Relocation Costs of the Affected Entity, in agreeing or determining the amount of compensation the Entities or the Expert (as applicable) shall also assess the type of Activities that would need to be carried out by the Affected Entity and (where applicable) identify the coordinates of the geographical area within the Overlap Zone in which such Activities would need to be carried out by the Affected Entity for the Material Adverse Effect to arise;

**2.7.2** except in relation to compensation falling within limb (b) of the definition of Relocation Costs of the affected Entity and subject to Clause 2.8, the amount of such compensation shall become due and payable to the Affected Entity on the Claims Settlement Date falling immediately following the date on which the Affected Entity gives notice to the Notifying Entity that it has carried out the Activities of the type and (where applicable) within the geographical area identified in Clause 2.7.1.

**2.7.3** in relation to compensation falling within limb (b) of the definition of Relocation Costs of the Affected Entity, in agreeing or determining the amount of compensation the Entities or the Expert (as applicable) shall also identify the coordinates the geographical area within the Overlap Zone that would need to be developed by the Affected Entity for the Material Adverse Effect to arise;

**2.7.4** in relation to compensation falling within limb (b) of the definition of Relocation Costs of the Affected Entity and subject to Clause 2.8, the amount of such compensation shall become due and payable to the affected Entity on the Claims Settlement Date following the date on which the Affected Entity gives notice to the Notifying Entity that it has been granted the Wind Lease or Carbon Lease (as applicable) over a geographical area that includes the geographical area identified in Clause 2.7.3.

**2.8** Notwithstanding any other provision of this Agreement, compensation for Relocation Costs and Reprogramming Costs shall only be payable to an Entity on the applicable Claims

Settlement Date where, and only to the extent that, the aggregate of all Relocation Costs and Reprogramming Costs of that Entity under this Agreement in the immediately preceding calendar year have exceeded £100,000.

**2.9** Where a notice of Proposed Infrastructure locations or Programme of Activities has been issued pursuant to this Agreement and:

**2.9.1** no Material Adverse Effect is identified as arising pursuant to this Agreement; or

**2.9.2** commercial agreement or Expert determination (in accordance with Clause 6) is secured in relation to the same,

no Material Adverse Effect shall thereafter arise under this Agreement from such notified Proposed Infrastructure locations or Programme of Activities.

**2.10** Where a notice of Proposed Infrastructure locations or Programme of Activities has been issued pursuant to this Agreement and compensation has been agreed or determined as becoming due and payable on the date set out in Clause 2.7.2 by one Entity to another Entity (including where an estimate of compensation has been finally agreed or determined pursuant to limb (b) (1) or (2) of the definition of Relocation Costs) such amount of compensation shall thereafter not be capable of any future reassessment for changed circumstances or otherwise except as provided for in Clause 7.3 or by agreement between the relevant Entities.

**2.11** Where the Notifying Entity gives notice to the Affected Entity of its Proposed Infrastructure locations or Programme of Activities and the Affected Entity, acting reasonably considers that the proposals in such notice will give rise to a Material Adverse Effect but one which would give rise to a claim for compensation equal to or less than £100,000 in value then the following shall apply:

**2.11.1** the Affected Entity shall, subject to Clause 2.12 below, give notice to the Notifying Entity advising that it considers that the proposed Activities would give rise to a Material Adverse Effect and its assessment of the impact of such Material Adverse Effect;

**2.11.2** the Entities shall seek to agree on the amount that would become payable to the Affected Entity (if the terms of Clause 2.8 are satisfied for the relevant calendar year) arising from such Material Adverse Effect and/or any changes to the Programme of Activities or location of Proposed Infrastructure and mitigation strategies that may be adopted;

**2.11.3** if the Entities cannot agree on the amount of compensation that may be payable, then the Affected Entity shall be entitled to refer the matter to the Expert for determination in accordance with Clause 6 within 30 days following the end of the calendar year in which the notification is given by the Notifying Entity where the Affected Entity, acting reasonably, considers that the aggregate amount of compensation due to it from the Notifying Entity due to Material Adverse Effects arising from Activities specified in notices given by the Notifying Entity in the relevant calendar year exceeds £100,000;

**2.11.4** the Affected Entity shall be entitled to refer all such matters to the Expert in one application requesting that he determine the amount of compensation arising from all notices from the Notifying Party in the relevant calendar year giving rise to a Material Adverse Effect where the Entities have not reached agreement;

2.11.5 the Notifying Entity shall be entitled to proceed with such Activities pending the outcome of such determination;

2.11.6 in the event that the Expert's determination:

- (i) accords fully with the Affected Entity's assessment then the Notifying Entity shall bear the costs associated with the determination.
- (ii) results in compensation being payable to the Affected Entity (taken together with any sums agreed between the Entities) of less than £100,000 for the relevant calendar year then the Affected Entity shall bear the costs associated with the determination;
- (iii) results in an amount of compensation being payable to the Affected Entity which does not reflect either (i) or (ii) above, the Entities shall bear the costs of the determination in the proportions determined by the Expert.

2.12 The Affected Entity shall not give notice to the Notifying Entity in terms of Clause 2.11 above where its assessment of the impact of any Activities in a notification would give rise to a Material Adverse Effect where the cost, losses and/or expenses suffered or incurred by the Affected Entity would be less than £10,000 in aggregate.

2.13 This Agreement shall apply to each project where any part of that project is within the Overlap Zone and the provisions may therefore apply to more than one project at the same time.

### 3 Pre-Lease phase arrangements

3.1 A project shall be considered to be in the "consenting phase" where one of the following conditions is satisfied:

3.1.1 with respect to the Carbon Entity, the Carbon Entity has submitted its draft Facilities Specification and draft Specification (as each term is defined in the Carbon AfL) to the Commissioners for approval together with all information that the Commissioners may reasonably have required to enable them to make a decision whether or not to approve them pursuant to the terms of the Carbon AfL including in respect of its Activities over all or a part of the Overlap Zone, and has not secured a Carbon Lease; or

3.1.2 with respect to the Wind Entity, the project has secured a Wind AfL in respect of its Activities over any part of the Overlap Zone, and has not secured a Wind Lease.

Until a project (or a phase of a project) has entered the consenting phase, it is acknowledged and agreed that there is greater flexibility in location and programming of that Entity's Activities.

3.2 This Clause 3.2 applies where only one of the Entities has a project in the consenting phase. In relation to a project that is in the consenting phase the Notifying Entity may provide details of its Proposed Infrastructure (the location of such infrastructure being Demonstrably consistent with Good Industry Practice at the time of notification by the Notifying Entity for comparable offshore projects in the relevant industry sector) and/or the Programme of Activities that it is intending to implement (the initial Baseline). The Affected Entity shall thereafter propose locations for its Proposed Infrastructure and plan its Programme of Activities in a manner that to the extent practicable minimises the impact on the initial Baseline. Each Entity may by further notice, acting reasonably, modify its

Proposed Infrastructure locations and/or its Programme of Activities, and the Entities shall assess the impact on the other Entity resulting from such changes against the then current Baseline in accordance with the terms of this Agreement.

**3.3** Until both Entities have projects in the consenting phase, the Entities shall meet quarterly to discuss their respective actual and proposed Activities. In or pursuant to such quarterly meetings each Entity shall act reasonably in providing to the other Entity information (other than third party proprietary information) on its Activities, and such information shall be at a sufficient level of detail to allow the other Entity to understand the impact on its proposed Activities and locations of Proposed Infrastructure and shall be provided as early as is reasonably practicable. Where any information provided by either Entity to the other changes following a meeting and prior to the next meeting, the relevant Entity shall forthwith notify the other. Each Entity shall provide the other with such information as that other Entity may, acting reasonably, request to assess impacts.

**3.4** This Clause 3.4 applies from such time as both Entities have projects that have entered the consenting phase until such time as those projects have entered the construction phase or one is in the construction phase and the other in the operational phase (from which time Clause 4 shall apply). The Entities shall meet quarterly to discuss their respective actual and proposed Activities during the consenting phase and in the construction phase. In or pursuant to such quarterly meetings each Entity shall act reasonably in providing to the other Entity information (other than third party proprietary information) on its Activities, and such information shall be at a sufficient level of detail to allow the other Entity to understand the impact on its proposed Activities and locations of Proposed Infrastructure and shall be provided as early as is reasonably practicable. Where the Notifying Entity intends to: (a) apply for consent or approval from the Commissioners in relation to its Proposed Infrastructure locations (including where this relates to the exercise of its Option to secure a lease under a Relevant Agreement); or (b) make any amendment to its Proposed Infrastructure locations and/or Programme of Activities, the Notifying Entity shall notify the Affected Entity and provide details of the Programme of Activities and (where applicable) the information it intends to submit to the Commissioners and provide further information as to its programme and methodology and other Activities (subject to the terms of Clause 12) required to construct such Proposed Infrastructure. The Notifying Entity shall make a good faith assessment of the impact against the then current Baseline and set out the steps by which it proposes to mitigate or compensate for any Material Adverse Effect (Pre-Operational). If either the Notifying Entity or the Affected Entity considers that a Material Adverse Effect (Pre-Operational) will arise from the Proposed Infrastructure locations or the Programme of Activities and the Entities do not reach commercial agreement as to the mitigation strategy or compensation for Relocation Costs and/or Reprogramming Costs arising from any Material Adverse Effect (Pre-Operational) within a reasonable period, which shall be not less than 30 days of the date of notification by the Notifying Entity, then, subject to Clauses 2.10 to 2.12, either Entity shall be entitled to refer the matter to the Expert for determination in accordance with Clause 6 provided such Entity does so within a further period of 30 days. The Notifying Entity shall not proceed with its changed Programme of Activities and/or apply for any approval for locations of its Proposed Infrastructure in terms of its Relevant Agreement (as applicable) until such time as the Entities have reached agreement or the Expert has made its determination in accordance with Clause 6. No Material Adverse Effect (Pre-Operational) shall arise under this Clause 3.4 where the application for consent from the



Commissioners specifies Proposed Infrastructure locations that have previously been notified to the Affected Entity pursuant to Clause 3.2.

#### **4 Construction Phase**

- 4.1** As early as reasonably practicable and no later than submission of its application for a Storage Permit (as such term is defined in the Storage AfL), the Carbon Entity shall notify the Wind Entity of its Programme of Activities and methodology for undertaking the works. As early as reasonably practicable and no later than entering into a Wind Lease, the Wind Entity shall notify the Carbon Entity of its Programme of Activities and methodology for undertaking the works to construct the Proposed Infrastructure.
- 4.2** The Entities shall set up an Interface Management Group comprising the project managers for each Entity's project, and such other technical person as each determines necessary, who shall meet as frequently as either Entity considers necessary to ensure a smooth co-existence of both project programmes.
- 4.3** The Entities shall, through the Interface Management Group, act reasonably and in good faith to determine the interfaces between the Entities' respective project programmes and methodologies and to determine a least cost solution to any programme, methodology or siting conflicts. Each Entity shall take into account the plans of the other in preparing its programmes and methodologies.
- 4.4** Each Entity shall provide the other with such information (other than third party proprietary information) on its programme and methodology of Activities at a sufficient level of detail to allow the other to understand the impact on the other's programmes and Activities.
- 4.5** Where the Notifying Entity departs from its then current notified Proposed Infrastructure locations or Programme of Activities, the Notifying Entity shall notify the Affected Entity and, prior to such application shall make a good faith assessment of the impact of such new Proposed Infrastructure locations or amended Programme of Activities on the Affected Entity and set out the steps by which it proposes to mitigate or compensate for any Material Adverse Effect (Pre-Operational). If the Affected Entity considers that a Material Adverse Effect (Pre-Operational) will arise and the Entities do not reach commercial agreement as to the mitigation strategy or compensation for Relocation Costs and/or Reprogramming Costs arising from any Material Adverse Effect (Pre-Operational) within a reasonable period, which shall be not less than 30 days of the date of notification by the Notifying Entity, then subject to Clauses 2.10 to 2.12, either Entity shall be entitled to refer the matter to the Expert for determination in accordance with Clause 6. Where any Proposed Infrastructure locations or Programme of Activities have been referred to the Expert, the Notifying Entity shall not carry out the Activities in question or apply for the new approval or variation to its approval for development for such Activities until such time as the Expert has made its determination in accordance with Clause 6 and where necessary Commissioners' consent has been obtained under Clause 2 or a commercial agreement between the Entities has been documented in writing in accordance with Clause 2 or the Notifying Entity has notified the Commissioners and the Affected Entity that, pursuant to the Expert's determination it does not intend to amend its Proposed Infrastructure locations or Programme of Activities.

## **5 One or both projects in operation phase**

- 5.1** This Clause 5 shall apply in relation to each Entity's projects in the Overlap Zone where the Commercial Operation Date has been achieved.
- 5.2** Each Entity shall plan its Activities in a manner that to the extent practicable minimises the impact on the other Entity's operational projects.
- 5.3** Each Entity may offer to meet with the other Entity at six monthly intervals or at such frequency as the Entities reasonably determine necessary to discuss the respective Entities' Activities in the Overlap Zone. Each Entity shall propose locations for any further infrastructure and plan its Activities in a manner that to the extent practicable minimises the impact on the other Entity's projects. In or pursuant to such six monthly meetings each Entity shall act reasonably in providing to the other Entity information (other than third party proprietary information) on its Activities, and such information shall be at a sufficient level of detail to allow the other Entity to understand the impact on that other Entity's proposed projects and Activities within the Overlap Zone. Where any information provided by either Entity to the other changes following a meeting and prior to the next meeting, such Entity shall forthwith notify the other. Where the Entities have agreed to a programme and methodology for Activities to be undertaken in relation to operation and maintenance and/or repairs, the Entities shall adhere to such agreed programme and methodology.
- 5.4** Where either Entity intends to carry out Activities which may impact on the Activities of the other and/or which are emergency or unplanned repairs and/or maintenance that require to be carried out otherwise than in accordance with the agreed programme and methodology, the Notifying Entity shall notify the Affected Entity and, prior to undertaking such Activities shall make a good faith assessment of the impact of such Activities on the Affected Entity and set out the steps by which it proposes to mitigate or compensate for any Material Adverse Effect (Post-Operational). If either Entity considers that a Material Adverse Effect (Post-Operational) will arise from the Activities and the Entities do not reach commercial agreement as to the mitigation strategy or compensation for the Material Adverse Effect (Post-Operational) within a reasonable period, which shall be not less than 30 days of the date of notification by the Notifying Entity of such Activities, either Entity shall be entitled to refer the matter to the Expert for determination subject to Clauses 2.10 to 2.12. Where specified Activities have been referred to the Expert, the Notifying Entity shall not proceed with or apply to the Commissioners for consent or approval for such Activities if required in terms of the Relevant Agreement subject to Clause 5.5, until such time as the Expert has made its determination in accordance with Clause 6 and Commissioners' consent/approval has been obtained under Clause 2.
- 5.5** In the event that either Entity requires to carry out Activities which are not in accordance with the agreed Programme of Activities at the relevant time but are necessary as a result of an emergency or to carry out a repair, such Entity shall be entitled to carry out its Activities prior to the Expert's determination having been made but shall be required to make payment of any compensation agreed or subsequently determined to be paid by the Expert and shall have regard to its obligations under this Agreement including Clause 2.1.

## **6 Independent Expert Determination**

- 6.1** The provisions of this Clause 6 shall apply wherever under the terms of this Agreement any person is to be appointed as the independent expert (the "**Expert**") or any matter is to

be referred to an Expert or where the Entities agree that a dispute between them shall be resolved by an Expert.

**6.2** The procedure for the appointment of the Expert shall be as follows:

**6.2.1** the Entity seeking the appointment of the Expert (the “**Applicant**”) shall give Notice to the other Entity that a disagreement exists and that it wishes an Expert to be appointed to resolve the dispute, which Notice shall state:

- (i) reasonable details of the dispute the Applicant proposes to be resolved by the Expert; and
- (ii) the proposed terms of reference setting out the scope of the dispute to be referred to the Expert (and including remuneration of the Expert);

**6.2.2** the Entities shall endeavour to agree upon:

- (i) a single Expert with relevant commercial experience and expertise to resolve the matter in dispute; and
- (ii) the terms of reference setting out the scope of the dispute to be referred to the Expert (and including remuneration of the Expert);

**6.2.3** if, within the seven (7) days immediately following the date a Notice is given, the Entities have not agreed upon the identity of the Expert and his terms of reference, the matter shall be referred by the Applicant to the President of Energy Institute (the “**Appointing Authority**”) or its successors who shall be requested to select the Expert, together with a list of two alternative candidates in a strict order of preference clearly stating which alternative candidate is to be preferred over the other, ensuring that the Expert and the alternative candidates have the relevant commercial experience and expertise to resolve the dispute, and, if willing to do so, to the extent not already settled, settle the terms of reference of such Expert within thirty (30) days of the request and, in so doing, may take such independent advice as he thinks fit;

**6.2.4** upon an Expert being agreed upon or selected under this Clause 6.2, the Applicant shall give notice to such Expert of his selection and of the proposed terms of reference for his appointment and shall request him, within fourteen (14) days of such notice, to confirm to the Entities whether he is willing and able to accept the appointment on the terms proposed and whether he has any conflict preventing him from doing so;

**6.2.5** if the Expert:

- (i) is unwilling or unable to accept the appointment or the terms proposed; or
- (ii) has not confirmed his willingness and ability to accept such appointment within such fourteen (14) day period,

then (unless the Entities are able to agree upon the appointment of another Expert), the Entities or either of them shall forthwith notify the first alternative candidate of his selection and request him to confirm whether he accepts appointment as Expert in accordance with Clause 6.2.4, and if the first alternative candidate shall be either unwilling or unable to accept such appointment or shall not have confirmed his willingness and ability to accept such appointment within the said period of fourteen (14) days then (unless the Entities are able to agree

upon the selection of another Expert) the Entities or any of them shall forthwith notify the second alternative candidate of his selection and request him to confirm whether he accepts appointment as Expert in accordance with Clause 6.2.4, and if the second alternative candidate shall be either unwilling or unable to accept such appointment or shall not have confirmed his willingness and ability to accept such appointment within the said period of fourteen (14) days then (unless the Entities are able to agree upon the selection of another Expert) the matter may again be referred by the Applicant to the Appointing Authority, who shall be requested to make a further selection and the process shall be repeated until an Expert is found who accepts an appointment in accordance with the proposed terms of reference; and

- 6.2.6** if there is any dispute between the Entities on the amount of remuneration to be offered to the selected Expert or any other term of his terms of reference, then such amount or other term shall be determined by the Appointing Authority within twenty-one (21) days after the referral of that matter to it, whose decision shall be final and binding on the Entities. The appointment of the Expert shall be deemed to have been made upon his signing the terms of reference.

### **6.3** Restrictions

Any person duly appointed as an Expert under this Clause 6:

- 6.3.1** shall be entitled to act in such capacity, notwithstanding that at the time of the appointment or at any time before he gives his determination, he or his employer or any person directly or indirectly retaining him as a consultant has or may have some interest or duty that materially conflicts or may materially conflict with his function under this Agreement if he shall, before accepting such appointment, have disclosed any interest or duty of which he is aware that conflicts or may conflict with his function under such appointment and no Entity after such disclosure shall have reasonably objected to his appointment. If either Entity reasonably objects to such appointment within seven (7) days after such disclosure or within seven (7) days of becoming aware of any interest or duty described above on the grounds that it considers that there is a material risk of such interest or duty prejudicing the decision of the Expert, then the Expert shall be discharged from his office immediately upon receipt of a notification and shall immediately cease to act as Expert, and either Entity may apply to the Appointing Authority to make a further selection in accordance with the provisions of Clause 6.2.3. Upon the discharge of the Expert, all written submissions served by any Entity at any time before the discharge of the Expert shall stand as if the Expert had not been discharged but any oral hearings which may have been, or are currently being heard by the Expert shall be reheard by the replacement Expert; and
- 6.3.2** shall not, at the time of the appointment, be a director, an office holder or an employee of, or directly or indirectly retained as a consultant to, either of the Entities or any Affiliate of either of them nor shall it hold any significant financial interest in an Entity nor shall it hold a shareholding equal to or more than one percent (1%) of the issued share capital of any class in an Entity or an Affiliate of an Entity.

### **6.4** Terms of Reference

The terms of reference of the Expert shall provide that:

- 6.4.1** within the fourteen (14) days immediately following the confirmation of his appointment, the Expert shall determine any dispute between the Entities as to the scope of the dispute that has been referred to him, give directions as to the future conduct of the matter and from time to time give such further directions as he shall see fit. In the event of any dispute as to the procedural rules the Expert shall have the power to determine the procedure, and such determination shall be final and binding on the Entities;
- 6.4.2** Each Entity shall submit to the Expert with a copy to the other within thirty (30) days immediately following the confirmation of appointment of the Expert, its Proposed Infrastructure locations or Programme of Activities, any Material Adverse Effect (including without limitation taking into account likely availability of goods, equipment, materials and/or vessels) and mitigating steps it believes could reasonably be taken together with any documentation to support that view and its assessment of compensation that should be payable. The Expert shall take into account the intent of this Clause, as specified herein, and be entitled to obtain such independent professional and technical advice as it may reasonably require.
- 6.4.3** The Expert shall within thirty (30) days thereafter, or if earlier thirty (30) days from receipt of the last submission from either Entity, provide written conclusions specifying whether in his view the proposed locations of its Proposed Infrastructure and/or Programme of Activities will cause a Material Adverse Effect, and if so may specify:
- (i) any reasonable changes to either Entity's Proposed Infrastructure locations and/or Programme of Activities that he requires to remove or mitigate the Material Adverse Effect; and
  - (ii) any material and unavoidable Relocation Costs and/or Re-programming Costs or other compensation (in the case of a Material Adverse Effect (Post-Operational)) that he believes should be payable by the Notifying Entity to the Affected Entity arising from the Material Adverse Effect that cannot be mitigated.
- 6.4.4** The Expert may request oral submissions to be made by either Entity. In the event that the Expert shall request oral submissions to be made, the Entity requested to make such submissions shall give the other Entity not less than seven (7) days' notice of the time and place where such submissions are to be made and shall promptly afford the other Entity the opportunity to be present. The Entity shall arrange for a transcript of any oral hearing to be made. The Expert may order disclosure of any information provided by one Entity to the other Entity, other than:
- (i) any price sensitive data, documents or information; or
  - (ii) any data, documents or information which is not relevant to the dispute in question, the relevancy of such data, documents or information being as the Expert may determine
- 6.4.5** In the event that one or other of the Entities defaults in complying with any procedural direction made by the Expert, the Expert may after the expiry of the deadline given for compliance with that procedural direction (and any extension which the Expert may, at his discretion, provide), the Expert may continue with his determination notwithstanding the default of such Entity.

**6.4.6** The Expert shall:

- (i) give a written determination and shall give full written reasons for his determination; and
- (ii) make available to the Entities a draft of his determination and draft written reasons for his determination together with a statement of the facts he has relied on and any assumptions he has made at least seven (7) days before formal delivery of his determination for the purpose of affording the Entities an opportunity to draw to his attention any factual error or manifest misconception.

**6.4.7** If within a reasonable period (which shall not without the prior written consent of the Entities exceed sixty (60) days after the acceptance by an Expert of the appointment) the Expert shall not have rendered a determination then (at the request of any Entity, copied to the Expert) a new Expert shall be appointed under the provisions of Clause 6.2.3 and upon the acceptance of the appointment by such new Expert, such acceptance to be notified to the previous Expert as soon as is practicable, the appointment of the previous Expert shall cease provided that if the previous Expert shall have rendered a determination prior to the date upon which the new Expert accepts the appointment such determination shall be binding upon the Entities and the instructions to the new Expert shall be withdrawn.

**6.4.8** Not an Arbitrator

The Expert shall act as an expert and shall not act as an arbitrator and accordingly the provisions of English law relating to arbitration shall not apply to such Expert or his determination or the procedure by which he reaches his determination.

**6.4.9** Immunity from suit

Save for circumstances where the Expert has acted in bad faith, or where the Expert has failed to render a determination within a reasonable time or at all, the Expert shall have no liability to the Entities arising out of or in connection with his appointment as Expert under this Agreement.

**6.4.10** Expert's Decision Final

The determination of the Expert shall be final and binding upon the Entities except in the case of fraud or manifest error or failure by the Expert to disclose any interest or duty which conflicts with his functions under his appointment as Expert.

**6.4.11** Costs

Subject to Clause 2.11, each of the Entities shall bear its own costs of providing all data, information and submissions given by it and the costs and expenses of all counsel, witnesses and employees retained by it but the costs and expenses of the Expert and any independent advisers to the Expert and (if he is appointed by the Appointing Authority) any costs of his appointment shall be borne as the Expert may determine having regard to the outcome of the determination and, if the fees are to be borne in different proportions, this will be stated as part of the determination.

**6.4.12** Communications

- (i) All communications between either Entity and the Expert shall be made in writing and a copy provided simultaneously to the other Party and no meeting between the Expert and either Entity shall take place unless both Entities receive at least five (5) days prior written Notice thereof.
- (ii) All data, information or documentation disclosed or delivered to the Expert in connection with his appointment as Expert shall be treated as confidential and Expert shall not disclose to any person or company any such data, information or documentation. All such data, information and documentation shall remain the property of the Entity disclosing or delivering the same and shall (together with all copies thereof) be returned to that Entity on completion of the Expert's work provided that the Expert may disclose solely for the purpose of the determination any data, information or documentation to employees of the Expert or his firm or company (if any) of the Expert or his or its professional advisers if such employees or subsidiary or professional advisers have prior to that disclosure entered into specific undertakings to maintain the confidentiality of that information, data and documentation.

## **7 Interaction with Relevant Agreements**

- 7.1** The Entities further agree that they shall not bring any claim, action, proceeding and/or demand against the Commissioners, under a Relevant Agreement or otherwise, in relation to any matter that has been determined (by the Expert (in accordance with Clause 6) or by agreement) pursuant to the terms of this Agreement.
- 7.2** Any Entity's rights under any Relevant Agreement shall be subject to, and each Relevant Agreement shall take effect subject to, such rights or Activities in favour of or for the benefit of any other Entity as are determined (by the Expert (in accordance with Clause 6) or by agreement) pursuant to the terms of this Agreement.
- 7.3** The Parties shall resolve any matters, which fall to be resolved under this Agreement, in accordance with the provisions of this Agreement and accordingly:
  - 7.3.1** no Party shall have any liability to any other Party for a breach of a Relevant Agreement to the extent such liability is a consequence of a determination or agreement made pursuant to this Agreement.
  - 7.3.2** no Party shall bring a claim against any other Party under a Relevant Agreement in respect of any matter which is capable of determination under this Agreement.
- 7.4** Where either:
  - 7.4.1** a Wind Entity ceases to be party to a Relevant Agreement; or
  - 7.4.2** a Carbon Entity ceases to be party to a Relevant Agreement,(the "**Exiting Entity**"), then save where the Exiting Entity's interest in the Relevant Agreement is being assigned to a New Entity, an Entity may notify the other Entities that it wishes the amount of compensation due as at that date to or from the Exiting Entity to be reassessed to remove any compensation for costs that will no longer arise, and the Entities shall in good faith seek to agree such reassessed compensation within 30 Business Days, failing which the matter may be referred by any Entity to the Expert for determination.

- 7.4 The amount of any compensation due to or from the Exiting Entity shall become due and payable within 10 Business Days of the later of the event described in Clause 7.4.1 or 7.4.2 as applicable and the agreement or determination of compensation pursuant to this Agreement where a Material Adverse Effect has been notified prior to the occurrence of the event described in Clause 7.4.1 or 7.4.2 and agreement or determination of any reassessed compensation pursuant to Clause 7.4. This Agreement shall cease to have effect and apply to the Exiting Entity (other than in relation to Clause 12 below) on the latest of such dates.

## **8 Succession**

- 8.1 The Carbon Entity shall procure on:

8.1.1 a transfer of the Carbon AfL or the Carbon Lease to a New Entity; and

8.1.2 (if the case) on the grant of the Carbon Lease to a New Entity,

that the New Entity shall enter into a deed of covenant with the other Parties and deliver an executed deed to the other Parties by which the New Entity agrees to perform and observe the obligations on the part of the Carbon Entity contained within this Agreement. The other Parties agree that they will also execute the deed of covenant and agree to perform and observe the obligations on their respective parts contained within this Agreement so far as the New Entity is concerned

- 8.2 Smart Wind Limited shall procure on the grant of a Wind AfL in respect of any part of the Overlap Zone to a New Entity that the New Entity shall enter into a deed of covenant with the other Parties and deliver an executed deed to the other Parties by which the New Entity agrees to perform and observe the obligations on the part of the Wind Entity contained within this Agreement insofar as it relates to the part of the Overlap Zone which is the subject of the Wind AfL. The other Parties agree that they will also execute the deed of covenant and agree to perform and observe the obligations on their respective parts contained within this Agreement so far as the New Entity is concerned.

- 8.3 Each Wind Entity shall procure on:

8.3.1 a transfer of a Wind AfL or a Wind Lease to a New Entity; and

8.3.2 (if the case) on the grant of a Wind Lease to a New Entity,

that the New Entity shall enter into a deed of covenant with the other Parties and deliver an executed deed to the other Parties by which the New Entity agrees to perform and observe the obligations on the part of the Wind Entity contained within this Agreement insofar as it relates to the part of the Overlap Zone which is the subject of the relevant Wind AfL or Wind Lease. The other Parties agree that they will also execute the deed of covenant and agree to perform and observe the obligations on their respective parts contained within this Agreement so far as the New Entity is concerned.

## **9 Notices**

- 9.1 Any notice, approval, instruction or other written communication required or permitted under this Agreement shall be sufficient if made or given to the other Party or Parties by personal delivery, by facsimile communication to the facsimile number set out below or by first class post, postage prepaid, to the address set out below:

9.1.1 if to the Commissioners, at:



Address: 16 New Burlington Place, London W1S 2HX

Attention: Legal Director

9.1.2 if to the Carbon Entity, at:

Address: 1 - 3 Strand, London, WC2N 5EH

Attention: Carbon Storage Manager, National Grid House, Warwick Technology Park, Gallows Hill, Warwick, CV34 6DA

9.1.3 if to the Wind Entity, at:

Address: 11<sup>th</sup> Floor, 140 London Wall, London EC2Y 5DN

Attention: General Manager, Smart Wind Limited

or to such other addresses or facsimile numbers provided to the other Parties in accordance with the terms of this Clause 9.

- 9.2 Notices or written communications made or given by personal delivery or by facsimile shall be deemed to have been sufficiently made or given when sent (receipt acknowledged), or if posted, 5 Business Days after being placed in the post, postage prepaid, or upon receipt, whichever is sooner.
- 9.3 Notices by an Entity of its Proposed Infrastructure locations and Programmes of Works, or formal responses to the same, shall be identified on their face as notices submitted pursuant to this Agreement.

## 10 Miscellaneous

- 10.1 This Agreement may be entered into in any number of counterparts, all of which taken together shall constitute one and the same instrument. Any Party may enter into this Agreement by executing any such counterpart.
- 10.2 No variation of this Agreement shall be effective unless in writing and signed by or on behalf of each of the Parties.
- 10.3 No failure or delay by any Party in exercising any right or remedy shall operate as a waiver of it, nor shall any single or partial exercise of any right or remedy preclude any other or further exercise of it or the exercise of any other right or remedy. Any waiver of a breach of this Agreement shall not constitute a waiver of any subsequent breach.
- 10.4 This Agreement incorporates the entire contract between the Parties and each Entity acknowledges that it has not entered into this Agreement in reliance upon any statement or representations made by any other Party.
- 10.5 Except as otherwise provided herein, this Agreement may not be amended except by a written agreement executed by each Party.
- 10.6 Any provision of, or the application of any provision of, this Agreement which is void, illegal or unenforceable shall not affect the validity, legality or enforceability of the remaining provisions of this Agreement and if such a provision is found to be void, illegal or unenforceable, it may be severed without affecting the enforceability of the other provisions of this Agreement.

## 11 Third Party Rights

- 11.1 Subject to Clause 11.2, a person who is not a party to this Agreement has no right under the Contracts (Rights of Third Parties) Act 1999 to enforce any term of this Agreement but this does not affect any right or remedy of a third party which exists or is available apart from that Act.
- 11.2 The obligations of any Party are intended to be enforceable by and enure for the benefit of any New Entity subject to that New Entity delivering a deed of covenant in favour of each other Party in accordance with Clause 8.

## 12 Confidentiality

As between each Entity and the Commissioners the confidentiality provisions of the Relevant Agreement shall apply to this Agreement as if set out here in full.

### 12.1 Definitions

**Confidential Information:** as between the Entities, any information (however recorded, preserved or disclosed) that any person exercising reasonable business judgment, would consider to be confidential or that was described or marked "confidential" at or shortly after disclosure hereunder, whether before, on or after the date of this Agreement in connection with:

- 12.1.1 any information that would be regarded as confidential by a reasonable business person relating to: (a) the business, affairs, customers, clients, suppliers, plans, intentions, or market opportunities of the Disclosing Party or of any Affiliate of the Disclosing Party; and (b) the operations, processes, product information, know-how, designs, trade secrets or software of the Disclosing Party or of any Affiliate of the Disclosing Party;
- 12.1.2 any information developed by the parties in the course of carrying out this Agreement;
- 12.1.3 but not including any information that:
- 12.1.4 is or becomes generally available to the public other than as a result of its disclosure by the Recipient or its Representatives in breach of this Agreement or of any other undertaking of confidentiality addressed to the Entity to whom the information relates (except that any compilation of otherwise public information in a form not publicly known shall nevertheless be treated as Confidential Information); or
- 12.1.5 was available to the Recipient on a non-confidential basis prior to disclosure by the Disclosing Party; or
- 12.1.6 was, is or becomes available to the Recipient on a non-confidential basis from a person who, to the Recipient's knowledge, is not bound by a confidentiality agreement with the Disclosing Party or otherwise prohibited from disclosing the information to the Recipient; or
- 12.1.7 was lawfully in the possession of the Recipient before the information was disclosed to it by the Disclosing Party; or
- 12.1.8 the Entities agree in writing is not confidential or may be disclosed; or

12.1.9 is developed by or for the Recipient independently of the information disclosed by the Disclosing Party.

**Disclosing Party:** an Entity which discloses or makes available directly or indirectly Confidential Information.

**Recipient:** an Entity which receives or obtains directly or indirectly Confidential Information in relation to the Disclosing Party or the Disclosing Party's Project.

**Representative:** employees, agents, sub-contractors, professional advisers, insurers, brokers, other authorised representatives of the Recipient and/or persons specifically notified by the Recipient to, and approved by, the Disclosing Party, any bona fide proposed assignee or new Entity (including an offshore transmission owner), the Planning Inspectorate or Infrastructure Planning Commission, or any other person authorised to determine a development consent order or otherwise necessary to secure a Necessary Consent.

## 12.2 Obligations of confidentiality

12.2.1 The Recipient shall keep the Disclosing Party's Confidential Information confidential and, except with the prior written consent of the Disclosing Party, shall not, and shall procure that its Representatives shall not: (a) use or exploit the Confidential Information in any way; or (b) disclose or make available the Confidential Information in whole or in part to any third party, except as expressly permitted by this Agreement; or (c) copy, reduce to writing or otherwise record the Confidential Information.

12.2.2 The Recipient may only disclose the Disclosing Party's Confidential Information to those of its Representatives who need to know this Confidential Information, provided that: (a) it informs these Representatives of the confidential nature of the Confidential Information before disclosure and ensures that its Representatives are obliged to keep the Confidential Information confidential in terms at least as extensive and binding upon the Representatives as the terms of this Agreement are upon the Entities; and (b) at all times, it is responsible for these Representatives' compliance with the obligations set out in this Agreement.

12.2.3 An Entity may disclose Confidential Information to the extent required by law, by any governmental or other regulatory authority, or by a court or other authority of competent jurisdiction provided that, to the extent it is legally permitted to do so, it gives the other party as much notice of this disclosure as possible and, where notice of disclosure is not prohibited and is given in accordance with this clause 12.2, it takes into account the reasonable requests of the other Entity in relation to the content of this disclosure.

12.2.4 The Recipient shall establish and maintain adequate security measures to safeguard the Confidential Information from unauthorised access or use.

12.2.5 Unless otherwise agreed by the Entities in writing, the confidentiality obligations and limitations set forth in this Agreement shall terminate 3 (three) years after the date of termination of this Agreement.

## 12.3 Reservation of rights and acknowledgement

12.3.1 All Confidential Information shall remain the property of the Disclosing Party. Each Entity reserves all rights in its Confidential Information. No rights, including, but not

limited to, intellectual property rights, in respect of an Entity's Confidential Information are granted to the other Entity and no obligations are imposed on the Disclosing Party other than those expressly stated in this Agreement.

**12.3.2** The Recipient acknowledges that damages alone would not be an adequate remedy for the breach of any of the provisions of this Agreement. Accordingly, without prejudice to any other rights and remedies it may have, the Disclosing Party shall be entitled to the granting of equitable relief (including without limitation injunctive relief) concerning any threatened or actual breach of any of the provisions of this Agreement.

**12.3.3** The Recipient shall be liable to the Disclosing Party for the actions or omissions of the Recipient's Representatives under this Agreement, as if they were the actions or omissions of the Recipient.

### **13 Governing Law and Jurisdiction**

**13.1** This Agreement and any non-contractual obligations arising out of or in connection with it and any documents to be entered into pursuant to it shall be governed by, and construed in accordance with, English law.

**13.2** The Parties irrevocably agree that the courts of England are to have non-exclusive jurisdiction to settle any disputes which may arise out of or in connection with this Agreement and that accordingly any proceedings arising out of or in connection with this Agreement shall be brought in such courts.

**IN WITNESS** whereof this Agreement has been executed as a deed on the date set out above

## Schedule 1

### Part 1

#### Lease Option Area

##### Lease Option Area Coordinates

Latitude	Longitude
54.043889	1.250556
54.265278	1.376111
54.378889	0.793056
54.156944	0.668611

Coordinates supplied in WGS84 decimal degrees

### Part 2

#### Zone 4

##### ZDA Area Coordinates

Latitude	Longitude	Latitude	Longitude
54° 13' 19.305" N	0° 28' 34.725" E	53° 49' 52.795" N	2° 54' 19.691" E
54° 12' 17.414" N	1° 12' 18.262" E	53° 48' 53.846" N	2° 54' 37.684" E
54° 00' 18.478" N	1° 38' 37.321" E	53° 47' 54.897" N	2° 54' 55.662" E
53° 59' 31.972" N	2° 06' 34.105" E	53° 46' 55.946" N	2° 55' 13.627" E
53° 59' 19.282" N	2° 13' 34.689" E	53° 45' 56.995" N	2° 55' 31.578" E
53° 58' 42.513" N	2° 32' 43.903" E	53° 44' 58.043" N	2° 55' 49.515" E
54° 01' 22.169" N	2° 48' 41.148" E	53° 44' 12.582" N	2° 56' 03.337" E
54° 01' 25.108" N	2° 48' 55.044" E	53° 43' 25.601" N	2° 56' 17.612" E
54° 01' 25.528" N	2° 48' 57.030" E	53° 43' 00.136" N	2° 56' 25.347" E
54° 01' 37.490" N	2° 49' 53.618" E	53° 42' 01.181" N	2° 56' 43.242" E
54° 01' 49.992" N	2° 50' 54.774" E	53° 41' 02.226" N	2° 57' 01.123" E
54° 01' 42.423" N	2° 50' 56.638" E	53° 40' 03.269" N	2° 57' 18.990" E
54° 01' 26.924" N	2° 51' 00.455" E	53° 39' 55.416" N	2° 57' 21.980" E
54° 01' 24.436" N	2° 51' 01.068" E	53° 38' 56.988" N	2° 57' 44.220" E
54° 00' 43.142" N	2° 51' 11.234" E	53° 38' 46.104" N	2° 57' 48.361" E
53° 59' 43.861" N	2° 51' 25.817" E	53° 38' 28.685" N	2° 57' 54.987" E
53° 58' 44.580" N	2° 51' 40.390" E	53° 38' 03.399" N	2° 58' 04.602" E
53° 57' 45.299" N	2° 51' 54.950" E	53° 38' 26.522" N	2° 57' 02.499" E
53° 57' 44.350" N	2° 51' 55.242" E	53° 38' 27.241" N	2° 57' 00.517" E
53° 56' 45.408" N	2° 52' 13.347" E	53° 38' 27.634" N	2° 56' 59.434" E
53° 55' 46.466" N	2° 52' 31.439" E	53° 38' 35.123" N	2° 56' 38.777" E

<b>Latitude</b>	<b>Longitude</b>	<b>Latitude</b>	<b>Longitude</b>
53° 54' 47.523" N	2° 52' 49.516" E	53° 39' 15.059" N	2° 54' 30.054" E
53° 53' 48.579" N	2° 53' 07.579" E	53° 39' 18.625" N	2° 54' 18.554" E
53° 52' 49.635" N	2° 53' 25.628" E	53° 48' 23.275" N	2° 24' 43.629" E
53° 51' 50.689" N	2° 53' 43.663" E	53° 49' 58.583" N	1° 59' 54.762" E
53° 50' 51.742" N	2° 54' 01.684" E	53° 50' 00.530" N	0° 29' 15.901" E

Coordinates supplied in WGS84 degrees minutes decimal seconds.

### **Part 3**

#### **Overlap Zone**

##### **Overlap Zone Coordinates**

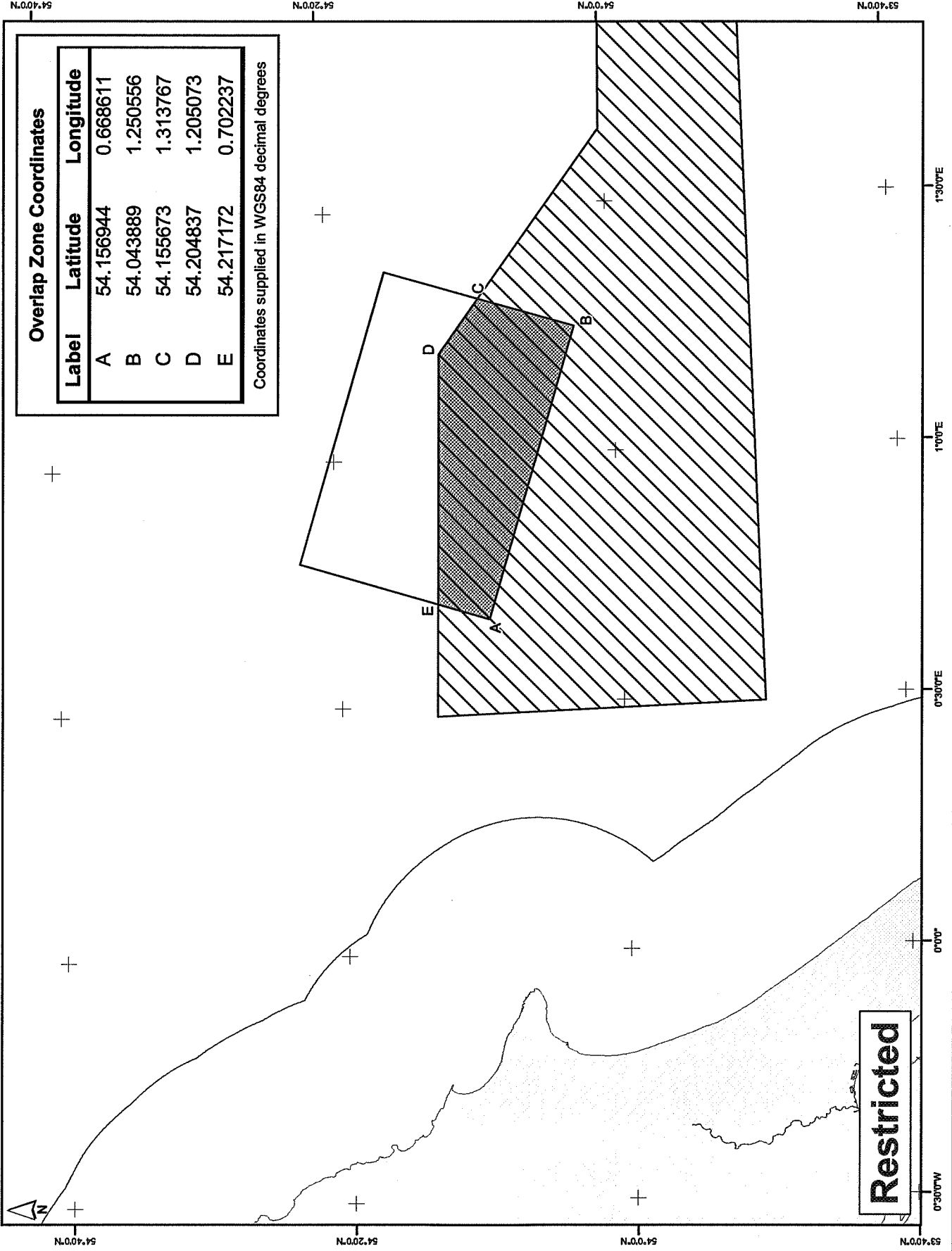
<b>Latitude</b>	<b>Longitude</b>
54.156944	0.668611
54.043889	1.250556
54.155673	1.313767
54.204837	1.205073
54.217172	0.702237

Coordinates supplied in WGS84 decimal degrees

**Schedule 2**

**The Plan**

# Overlap Zone of CCS Lease Option Area and Zone 4

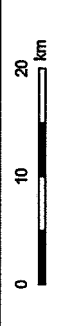


**Overlap Zone Coordinates**

Label	Latitude	Longitude
A	54.156944	0.668611
B	54.043889	1.250556
C	54.155673	1.313767
D	54.204837	1.205073
E	54.217172	0.702237

Coordinates supplied in WGS84 decimal degrees

- Overlap Zone
- CCS Lease Option Area
- Round 3 Wind Farm Zone
- Base Map**
- Territorial Waters Limit
- United Kingdom



**MaRS**  
Marine Resource System

MaRS1211/029  
26 Nov 2012  
Author : KW  
QA : KB  
Size: A4  
1:700,000

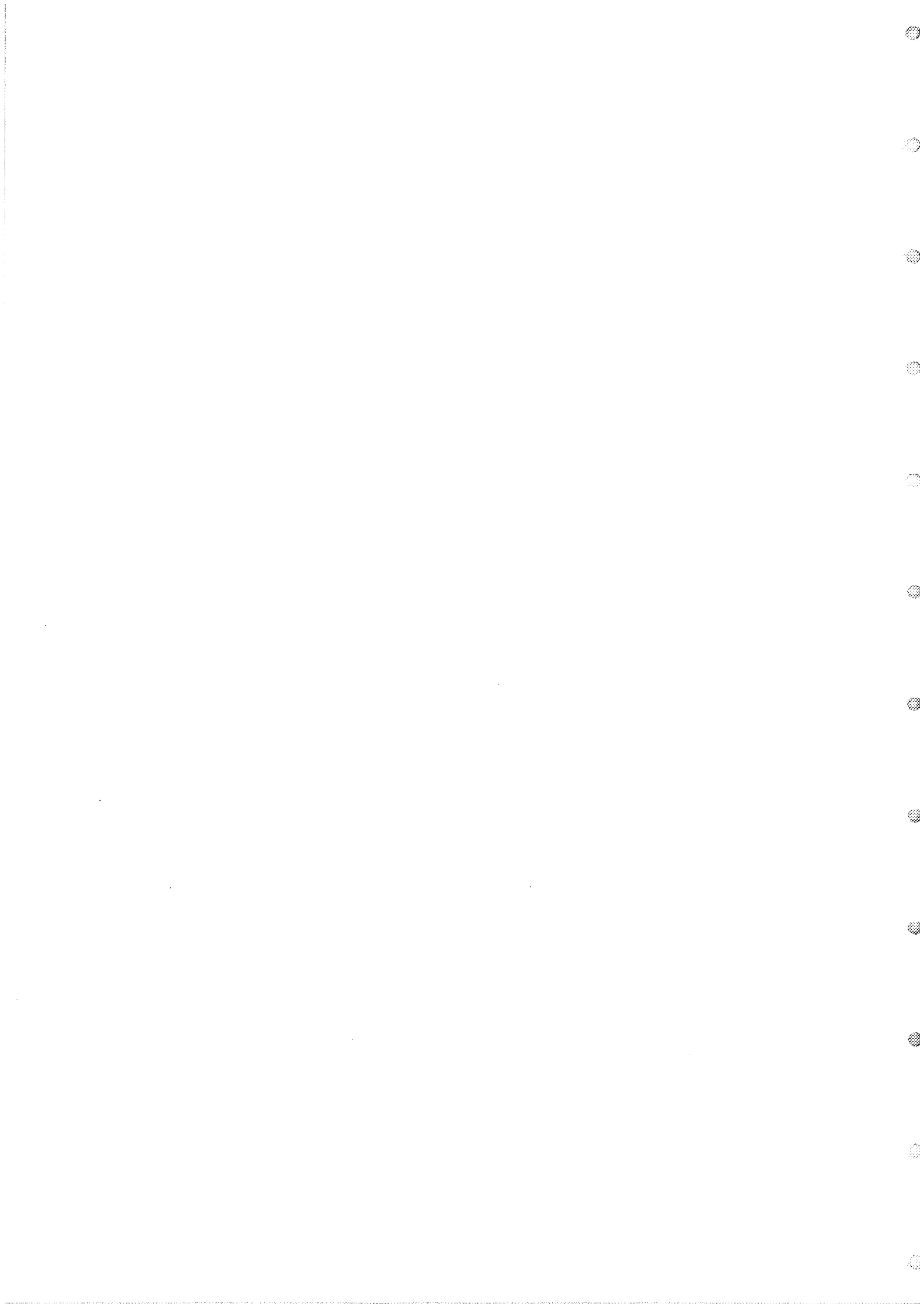
Positions shown relative to WGS 84. © Crown Copyright 26 Nov 2012.  
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**Restricted**







### **Schedule 3**

#### **Crossing Agreement principles**

1. The form of crossing agreement will be based on the Oil and Gas UK Industry Model Form: Pipeline Crossing Agreement (January 2009) or such other form published by Oil and Gas UK as may be current from time to time amended as necessary to reflect crossing of a pipeline by an electricity cable or cables, or vice versa.
2. The crossing agreement will apply to the Entities (being the parties owning and/or operating the pipeline and/or electricity cable) (the "Crossing Agreement Parties") that are the subject of the crossing agreement as the case may be.
3. The crossing agreement may cover more than crossing of the pipeline or cable as may be required in relation to other matters at the crossing location.
4. The liability of the Crossing Agreement Parties under each crossing agreement shall be limited to £25m (twenty five million pounds sterling) and such limitation shall apply to the initial work and any additional work undertaken under the crossing agreement.
5. Any work to be carried out by the Crossing Agreement Parties may be carried out in more than one phase.
6. The Safety Zone will be the area within 200m on either side of the pipeline.
7. The Safety Zone will be the area within 200m on either side of the cable.

**THE OFFICIAL SEAL of THE CROWN  
ESTATE COMMISSIONERS hereunto  
affixed was authenticated by:**

.....

**EXECUTED AS A DEED** by for and on behalf of

**NATIONAL GRID TWENTY NINE LIMITED** by: .....

Print name: .....

In the presence of:

Witness name .....

Address .....

Occupation

**EXECUTED AS A DEED** by for and on behalf of

**SMART WIND LIMITED** by:

Print name:

In the presence of:

Witness name

Address

Occupation

### APPENDIX 3

## BP'S SUMMARY OF THE INTERFACE AGREEMENT



	Clause summary	Commentary on proposed disapplication
1	<p><b>Recitals</b></p> <p>The first two recitals acknowledge that the Crown Estate ('TCE') has entered into a zonal development agreement with Smart Wind Limited, and into an agreement for lease with National Grid Twenty-Nine Limited.</p> <p>The third recital confirms the parties entered into the agreement to regulate and co-ordinate their activities within the Overlap Zone with a view to managing potential conflicts and resolving actual conflicts.</p>	<p>The Interface Agreement ('IA') was entered into at a point in time in which the then parties envisaged co-development within the Overlap Zone would be possible and/or only require minor readjustments to their development programme or the intended infrastructure locations, with limited commensurate compensation payable.</p> <p>This presumption of the feasibility of co-development underlies the rationale for and content of the provisions of the IA. In view of the change in circumstances whereby it is now understood that such co-development is not possible (for the reasons articulated in the bp Position Statement submitted at Deadline 1 and elaborated upon in bp's Deadline 2 response), it follows that the rationale for its provisions no longer exists. Furthermore, the effect of its provisions in this context would be to frustrate the achievement of the objectives of Government Carbon Capture Use and Storage policy.</p>
<b>CLAUSE 1 – INTERPRETATION AND DEFINITIONS</b>		
2	<p><b>Clause 1 – Interpretation and Definitions</b></p> <p>This clause sets out the relevant interpretation provisions and defined terms, which inform the interpretation of the rest of the agreement. Cross-reference is made to relevant definitions as necessary in the paragraphs below.</p> <p>It further provides (clause 1.2) that any covenant by (or implied to be made by) Her Majesty pursuant to the terms of the Agreement is made by TCE in exercise of the powers conferred by the Crown Estate Act 1961. It confirms that nothing in the Agreement imposes any liability on Her Majesty or anyone who reigns after her, nor on the TCE in any personal or private capacity.</p>	<p>This is protection afforded to TCE as a signatory to the agreement, in the context of their role as counter party to the relevant AfLs (or Zone Development Agreement as was the relevant agreement with the then Wind Entity at the time, but which has now been superseded by project specific AfLs and so is not discussed further below).</p> <p>However, the effect of this protection is specific to the terms of the IA and so to the extent the IA were disappplied, no protection from its terms would be required.</p> <p>Therefore the TCE would not be prejudiced by the disapplication of this clause.</p>
<b>CLAUSE 2 - Commissioners' consent for location of Proposed Infrastructure and Entities' notifications of Programmes of Activities</b>		
3	<p><b>Clause 2 – Commissioners' consent for location of Proposed Infrastructure and Entities' notifications of Programmes of Activities</b></p> <p>Clause 2.1 –</p>	<p>This provision clarifies both the purpose of the IA and also confirms the context within which it was prepared – an expectation that co-development within the Overlap Zone would be possible, subject to both parties working</p>



	Clause summary	Commentary on proposed disapplication
	<p>a. confirms the intent of the agreement is to provide a mechanism to ensure successful co-delivery of the respective projects within the Overlap Zone and to provide sufficient certainty to the parties to plan and implement their projects;</p> <p>b. notes the provisions are intended to provide a framework which incentivises the parties to work together and to plan their activities to give each other sufficient certainty to progress their respective projects;</p> <p>c. provides for the parties to carry out their obligations/exercise their rights under the IA (and the AfLs, where relevant) in good faith and in manner which does not unduly hinder the timely progress and development of the projects within the Overlap Zone; and</p> <p>d. further provides that where a Material Adverse Effect (as defined, and commented upon further below) has arisen, the parties are to mitigate, to the extent reasonably practicable, the impact of such effect on itself or the other entity.</p>	<p>together and through comparatively minor changes to the programme or the location of the infrastructure where necessary.</p> <p>bp has explained to the ExA that despite extensive engagement between the parties and refinements to the NEP design/footprint, such co-development across the entirety of the Overlap Zone is not feasible for delivering the ECC plan. The agreement is therefore not fit for its intended purpose.</p>
4	<p><b>Clause 2.2</b> provides for each party to consult with the other early and fully as part of any consultation process for any of its Necessary Consents (as defined). It also provides that neither party may lodge any objection or make any representation to any application of the other party for a Necessary Consent within the Overlap Zone.</p>	<p>It was clearly not contemplated that substantial, in-principle, objections would be necessary on the basis that co-existence/development was assumed.</p> <p>A waiver of this provision has now been entered into between bp and Orsted to ensure that both parties can fully participate in the relevant consent processes.</p>
5	<p><b>Clause 2.3</b> notes the parties agree to act in good faith in the negotiation of any necessary Crossing Agreement (as defined).</p>	<p>bp has re-produced this provision in the terms of its protective provisions (para 10 (see Annex 3 of bp's Deadline 2 submissions (<a href="#">REP2-062</a>))) and so there is no wider consequence to its disapplication as part of the IA.</p>
6	<p><b>Clause 2.4</b> notes the discretion open to TCE under the respective AfLs to approve, or withhold approval of, the siting of the parties' respective Proposed Infrastructure (as defined).</p>	<p>This provision assists with the read-across between the IA and the relevant AfLs. It does not impose any new legal obligation, or bestow any greater power on TCE in its role as the approving body under the AfLs, and so its disapplication has no wider practical or legal consequence – the relevant provisions will continue to exist under the respective AfLs.</p>



	Clause summary	Commentary on proposed disapplication
7	<b>Clauses 2.5 and 2.6</b> apply to circumstances where the entities have reached commercial agreement in relation to any changes to their Activities (as defined) or the payment of any compensation pursuant to the IA or the Expert (as defined) has made a determination pursuant to the IA, and clarify the subsequent procedural/documentation implications.	These are ancillary provisions, and so it is appropriate to disapply their effect for the same reasons advocated in respect of the primary provisions to which they relate (discussed below).
8	<b>Clauses 2.7 to 2.12</b> - these provisions set out certain procedural steps to follow in assessing, and depending on, the level of compensation resulting from a Material Adverse Effect as a result of the notifying party's activities.	For immediate purposes, these procedural steps are of less relevance than the calculation of the compensation figure and how it is to be determined which is covered subsequently in the IA. We comment substantively against such provisions below, and no further commentary is considered necessary against their ancillary provisions in these specific clauses other than to recognise that the thresholds referenced of £100,000 (clauses 2.8 (more than)) and 2.11 (less than) and £10,000 (clause 2.12 (less than)) again recognise the disparity between the circumstances/mitigation envisaged at the time the IA was entered into and the present day reality where no co-development is considered possible across the entirety of the Overlap Zone.
9	<b>Clause 2.13</b> – confirms that the IA applies to any project, or part of a project, within the Overlap Zone and can apply to more than one project at the same time.	This is a discrete provision and is no longer required to the extent the IA is disapplied.
<b>CLAUSE 3: PRE-LEASE PHASE ARRANGEMENTS</b>		
10	<b>Clause 3.1</b> – clarifies when projects are considered to be in the 'consenting phase' for the purpose of the IA, which has implications for the subsequent provisions in clause 3.	<p>To confirm, Orsted (as Wind Entity) are in their 'consenting phase'; however, bp are still to reach their 'consenting phase' as defined under the terms of the IA.</p> <p>This is not reflective of any greater maturity in the Orsted development or advancement in the consenting process, but rather it is simply reflective of the trigger points in the IA being confusingly linked to inconsistent milestones within the respective AfLs (with Orsted considered to be in the consenting phase upon the securing of its AfL, but bp (as the Carbon Entity) not considered to be in the consenting phase until they have submitted draft documentation for approval from the TCE pursuant to the terms of its AfL).</p> <p>It is noted the final sentence in this clause references a project having greater flexibility in location and programming of activities when not in its 'consenting phase'. bp has explained in Section 10 of its deadline 1</p>





	Clause summary	Commentary on proposed disapplication
		<p>submission (<a href="#">REP1-057</a> (Appendix 2, electronic page number 134) that it has carried out technical optimisation to reduce safety zones and vessel turning circles to the minimum permissible, but that further technical optimisation is not feasible due to the immovability of the Endurance Store. The flexibility anticipated by the IA does not exist in reality, and is a further example of the principles of the IA being at odds with the present day project reality.</p>
11	<p><b>Clause 3.2</b> – this applies in circumstances where only one project is in the 'consenting phase' and enables such party to provide details of its Proposed Infrastructure and/or Programme of Activities (each as defined) that it is intending to implement. This sets the "Initial Baseline". The other party is then obliged to develop its Proposed Infrastructure and Programme of Activities in a way which minimises, to the extent practicable, the impact on the Initial Baseline. It further provides for modifications to the Baseline.</p>	<p>Many of the submissions bp makes against clause 3.4 below apply equally to this clause 3.2, but are not repeated here, to avoid duplication.</p> <p>It is clear though that, as set out above, the flexibility envisaged for the project not in the 'consenting phase' (in present circumstances, bp as the Carbon Entity) does not exist, and so the assumption that the affected project has the ability to simply design their scheme around the Initial Baseline is flawed.</p>
12	<p><b>Clause 3.3</b> – provides for the parties to meet regularly to discuss their proposed projects and provide necessary associated information until the time that both projects are in the 'consenting phase'.</p>	<p>As explained in bp's Deadline 1 submission (<a href="#">REP1-057</a>, Appendix 2), this engagement has been occurring and the effect of this provision has been replicated by bp in para 7 to 9 of the protective provisions to ensure on-going engagement between the parties (where necessary) going forward.</p>
13	<p><b>Clause 3.4</b> – this clause applies when both parties are in their 'consenting phase' and until such time as the parties enter their construction phase, or beyond. It provides that:</p> <ul style="list-style-type: none"> <li>a. the parties are to meet regularly to discuss their proposed projects/provide necessary information. This continues the practice established under prior clause 3.3 (described above) and its effect is also provided for under para 7 to 9 of bp's protective provisions;</li> <li>b. where a party (the Notifying Entity) intends to (a) apply for consent/approval from TCE in relation to its Proposed Infrastructure locations, or (b) make any amendment to such locations and/or Programme of Activities, it must first notify the other party (the Affected Entity) and provide specified details;</li> <li>c. the Notifying Entity is to make a "good faith assessment" of the impact against the then current Baseline and set out the steps by which it</li> </ul>	<p>Set in the context of a scenario where both projects could co-exist, the provisions in clause 3.4 are understandable and could provide the framework through which development solutions and modest compensation payments are agreed.</p> <p>However, in the present circumstances, where co-development across the entirety of the Overlap Zone is not feasible for delivering the ECC plan and one project may need to proceed at the expense of the other, its provisions introduce too great an uncertainty/risk to regulate the matter.</p> <p>Whilst it is considered the risk/uncertainty applies to both parties, regardless of which one acts as the 'Notifying Entity', we focus the submissions below purely through the prism of the uncertainty applying to bp in its promotion of NEP:</p> <ul style="list-style-type: none"> <li>a. whilst bp considers Orsted would be able to adequately re-locate its infrastructure in the residue of its AfL area (for the</li> </ul>



	Clause summary	Commentary on proposed disapplication
	<p>proposes to mitigate or compensate for any Material Adverse Effect. A "Material Adverse Effect (Pre-Operational)" is defined to mean anything which demonstrably gives rise to Relocation Costs or Re-programming Costs;</p> <p>d. Relocation Costs are extensively defined, but broadly capture any additional costs/expenses that would be incurred by the Affected Entity to accommodate the Notifying Entity's Activities (e.g. the expenses necessary to incur in order to implement the revised plans), but also, where it is either not possible (reasonably and commercially) to relocate their affected infrastructure within the relevant project site to accommodate the other party's Activities, or where it is possible, but the performance of the project will be impacted (e.g. in the case of wind turbines, through a reduced power input), then the diminution of market value of the project (with the basis of the calculation set out in the definition);</p> <p>e. Reprogramming Costs mean the additional costs/expenses incurred in modifying and implementing the modified development;</p> <p>f. If either party considers that a Material Adverse Effect will arise from the Proposed Infrastructure locations or the Programme of Activities and the parties do not reach commercial agreement as to the mitigation strategy or compensation necessary then either party can refer the matter to an Expert for determination. The Expert provisions are discussed further below;</p> <p>g. The Notifying Entity shall not proceed with its Programme of Activities or apply for approval of its Proposed Infrastructure locations from TCE under its AfL until the parties have reached agreement or the Expert has made its determination; and</p> <p>h. No Material Adverse Effect can be claimed where the application for approval from TCE is consistent with the Proposed Infrastructure locations previously notified to the Affected Entity under clause 3.2.</p>	<p>reasons set out in bp's Deadline 1 submission (<a href="#">REP1-057</a>, Appendix 2, Section 13 (electronic page numbers 137 to 139)), it is possible that an Expert may determine otherwise and find for a significant compensation claim reflecting a perceived diminution of market value of Hornsea Project Four.</p> <p>b. the financing model for NEP (discussed in bp's Deadline 1 submission (<a href="#">REP1-057</a>, Appendix 2, Section 9 (electronic page numbers 132 to 134)) means that NEP will have limited ability to cover additional exceptional costs such as a compensation payment.</p> <p>c. In theory an Expert might determine a compensation payment in an amount which did not threaten the viability of the NEP project. However, in the event Orsted claimed a significant amount, an Expert might determine a substantial amount should be paid as compensation. The risk of a significant amount being claimed, and awarded by an Expert, jeopardises the investability and financiability of the project for the reasons set out in bp's Deadline 1 submission (<a href="#">REP1-057</a>, Appendix 2, Section 9 (electronic page numbers 132 to 134)).</p> <p>With regard to the provision summarised in (h) in the adjoining column, it is inappropriate to provide that no such adverse effect can occur in these circumstances. Given that there is no requirement for the parties to agree the initial baseline, and no ability for bp (as the Affected Entity) to adapt its project in view of such baseline, in circumstances where co-location in the entirety of the Overlap Zone is impossible this could effectively sterilise bp's development without offering an opportunity for bp to challenge this.</p>
<p><b>CLAUSE 4 – CONSTRUCTION PHASE</b></p>		



	Clause summary	Commentary on proposed disapplication
14	<p><b>Clause 4 – Construction Phase</b></p> <p>Clause 4 applies to when the respective projects enter their construction phase. It provides for:</p> <ul style="list-style-type: none"> <li>a. the notification of the Programme of Activities and methodology for undertaking the relevant works to construct the corresponding Proposed Infrastructure;</li> <li>b. the creation of an Interface Management Group;</li> <li>c. through such group, for both parties to act reasonably and in good faith to determine interfaces between the respective project programmes and methodologies and to determine a least cost solution where conflict exists (with each entity taking into account the plans of the other);</li> <li>d. the exchange of relevant information to allow each party to understand the impact of the other's programmes and Activities; and</li> <li>e. the steps to be followed when a Notifying Entity departs from its then notified Proposed Infrastructure locations or Programme of Activities (replicating the steps discussed at clause 3.4 above, with the same submissions applying (as appropriate)).</li> </ul>	<p>bp have provided for the creation of an interface management group and the sharing of information pursuant to paragraphs 7 to 9 of the protective provisions. These are considered to still be useful in the event that there is co-development in the wider area of the Southern North Sea; however, the rest of the provisions in this Clause 4 are unnecessary to the extent co-development within the Overlap Zone is no longer proposed for the reasons set out in the submissions above.</p>
<b>CLAUSE 5 – ONE OR BOTH PROJECTS IN OPERATION PHASE</b>		
15	<p><b>Clause 5 – One or both projects in operation phase</b></p> <p>Clause 5 applies in relation to each party's project in the Overlap Zone where their respective Commercial Operation Dates (as defined) have been achieved. It broadly provides for:</p> <ul style="list-style-type: none"> <li>a. each party to plan their Activities in a manner that to the extent practicable minimises the impact on the other's operational project;</li> <li>b. regular meetings and sharing of information to minimise the impact (to the extent practicable) of the projects on one another;</li> </ul>	<p>bp would refer to its submissions against clause 4 above, which are considered to apply equally to this clause 5.</p>



	Clause summary	Commentary on proposed disapplication
	<p>c. where any further Activities are planned (e.g. emergency or maintenance, beyond those previously agreed), then a similar process to that set out in clause 3.4 is to be followed in their respect.</p>	
<b>CLAUSE 6 – INDEPENDENT EXPERT DETERMINATION</b>		
16	<p><b>Clause 6 – Independent Expert Determination</b></p> <p>Clause 6 sets out the procedure to be followed in the event that an Expert is to be appointed under the IA, principally to determine a dispute between the parties pursuant to its terms, as well as certain associated provisions.</p> <p><b>Clause 6.2</b> provides that the parties are to endeavour to agree upon a single Expert with relevant commercial experience/expertise; however, if it's not been possible to do so within 7 days then the matter is to be referred to the President of the Energy Institute who is to select the Expert (with provisions for alternatives also provided where the selection is unwilling, or fails to confirm, their appointment).</p> <p><b>Clause 6.3</b> sets out potential restrictions on the appointment of the Expert.</p> <p><b>Clause 6.4</b> then goes on to describe the process which the Expert will follow in determining the dispute, the associated timescales and minor associated provisions not material to this current matter.</p>	<p>The Expert provisions may be appropriate in the context of a dispute between the parties that was limited in terms of the impact on practical delivery of, or commercial implications to, one party's project. However, set in the context of the present reality where co-development across the entirety of the Overlap Zone is not feasible for delivering the ECC plan, the Expert provisions are not suitable and attempting to resolve such a dispute through application of the Expert provisions would not be appropriate or in the public interest.</p> <p>Additionally, finding any person with the necessary commercial experience or expertise to resolve a dispute such as this which has no precedent, is significantly technical in nature and involves two very different sectors (offshore wind and carbon capture) would be extremely difficult if not impossible (for the parties and the President of the Energy Institute). As such, there is a very significant risk that any person appointed would not have the requisite experience, expertise and skills to properly assess and determine the referred matter, thereby compromising the Expert's decision. This has the potential to prevent the delivery of both schemes (e.g. in circumstances where the amount that the Expert determines would be payable to the Affected party is such that the party liable to pay instead chooses (as contemplated by the IA) not to implement their scheme).</p> <p>In circumstances where the IA is retained, and a party attempted to follow the process (so acting as Notifying Party), a dispute and Expert determination is almost inevitable and so the identified risk is actual, as opposed to potential. In bp's view this risk is such that it requires the disapplication of the IA to preserve the viability of NEP, particularly in the context of its regulatory model that is still uncertain.</p>
<b>CLAUSE 7 – INTERACTION WITH RELEVANT AGREEMENTS</b>		



	Clause summary	Commentary on proposed disapplication
17	<p><b>Clause 7 – Interaction with Relevant Agreements</b></p> <p>Clause 7 addresses the interaction between the IA and the parties' respective AfLs.</p> <p><b>Clause 7.1</b> provides that neither party may bring a claim against TCE under their AfLs or otherwise in relation to any matter determined pursuant to the terms of the IA.</p> <p><b>Clause 7.2</b> provides that each party's rights under their AfL are subject to any agreement reached or Expert determination pursuant to the terms of the IA.</p> <p><b>Clause 7.3</b> states that no party shall have any liability to the other party for a breach of their AfL where it is a consequence of a determination or agreement made pursuant to the IA, and no party shall bring a claim against the other under their AfL where it is capable of being determined under the IA.</p> <p><b>Clause 7.4</b> provides for the potential re-assessment of compensation due in circumstances where either party ceases to hold the AfL.</p>	<p>To the extent that the IA is disappplied then there is no longer a requirement to clarify its interaction with the AfLs. Specifically, there is no loss to TCE by the proposed disapplication of this clause 7, as there will no longer be any matter determined by the IA which may give rise to any potential claim under the AfLs.</p> <p>Were the ExA, and the SoS, satisfied with bp's submissions in relation to the need to disapply the key operative provisions applying earlier in the IA, then it is submitted that the same rationale applies for the disapplication of their associated, minor resulting provisions set out in this clause and those that follow.</p>
<b>CLAUSE 8 - SUCCESSION</b>		
	<p><b>Clause 8</b> imposes obligations on the parties in circumstances where they transfer their interest in their respective projects to a new entity.</p>	<p>This process has been followed and reflects how bp and Orsted have come to engage on the IA; however, it is not material for the purpose of this submission and so no further comment is made in its respect.</p>
<b>CLAUSE 9 - NOTICES</b>		
	<p><b>Clause 9</b> stipulates how notices required pursuant to the IA are to be issued.</p>	<p>Whilst not material to the submissions made in this document as to why the IA requires to be disappplied, bp have provided for an equivalent notice provision in paragraph 11 of the protective provisions and so there is no practical or legal consequence to its disapplication.</p>
<b>CLAUSES 10 AND 11 – MISCELLANEOUS</b>		
	<p><b>Clauses 10 and 11 – Miscellaneous and Third Party Rights</b></p>	<p>Clauses 10 and 11 contain standard contractual provisions which are not relevant to this submission, nor necessary to be carried into the protective</p>



	Clause summary	Commentary on proposed disapplication
		provisions, as their purpose is linked to the existence of the IA itself as a form of legal agreement rather than to the substance of its provisions.
<b>CLAUSE 12 - CONFIDENTIALITY</b>		
	<p><b>Clause 12</b> sets out the confidentiality obligations and confirms that the confidentiality provisions of the AfLs shall apply to the IA.</p>	<p>The value of this provision is linked to the information being disclosed.</p> <p>Much of the information shared between the parties to date is reflected in their respective application documents and so a matter of public record already.</p> <p>Further, in view of the reality of the position of the projects and their mutual incompatibility, it is not anticipated that further sensitive information will be necessary to be shared between the parties; however, were it necessary to do so, then separate confidentiality agreements could be readily entered into. It is not necessary for this provision to survive in order to facilitate such an exchange.</p>
<b>CLAUSE 13 – GOVERNING LAW AND JURISDICTION</b>		
	<p><b>Clause 13</b> confirms the IA is to be governed by, and construed in accordance with, English law and the courts of England have jurisdiction.</p>	<p>Whilst the protective provisions have been drafted in a manner to avoid scope for ambiguity/dispute from occurring, to the extent there was a need for dispute resolution pursuant to their terms then the relevant articles to the Hornsea Project Four DCO would apply and so no separate provision is required.</p>
<b>SCHEDULES</b>		
	<p><b>Schedule 1</b> sets out the relevant coordinates which contextualises the extent of the Overlap Zone and the parties respective AfL interests.</p> <p><b>Schedule 2</b> contains a plan delineating the same.</p> <p><b>Schedule 3</b> then contains principles to be applied to the negotiation of any Crossing Agreement.</p>	<p>bp's protective provisions contains a table of coordinates to inform the 'Exclusion Area' and 'Notification Area', which act in lieu of Schedule 1 (such coordinates having been updated as necessary to reflect the different areas) and a 'Protective Provisions Plan' which replicates the function of that plan contained at Schedule 2.</p> <p>bp have confirmed in the para 10 of the protective provisions that any crossing agreement required to facilitate each other's projects should be based on the Oil and Gas UK Industry Model Form, and updated the version reference to refer to the current 2015 version. No further principle from Schedule 3 was considered appropriate or necessary for inclusion in</p>



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	Clause summary	Commentary on proposed disapplication
		the protective provisions, but can be considered as part of any future crossing agreement where necessary.

**Herbert Smith Freehills LLP**

**APPENDIX 4**

**BP'S SUMMARY OF ORAL CASE AND WRITTEN SUBMISSIONS FROM ISH1 (12 APRIL  
2022)**



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**ISSUE SPECIFIC HEARING 1: MATTERS RELATING TO THE DRAFT  
DEVELOPMENT CONSENT ORDER (AGENDA ITEM 8 – PROTECTIVE  
PROVISIONS SUGGESTED BY THE APPLICANT AND BP WITH  
REGARD TO THE OVERLAP ZONE)**

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## 1. INTRODUCTION

- 1.1 This document contains the written summary of the oral submissions made by BP Exploration Operating Company Limited ("bp") at Issue Specific Hearing 1 ("ISH1") on matters relating to the DCO, and specifically item 8 on the agenda – the protective provisions proposed by Orsted Hornsea Project Four Limited ("Orsted") (as applicant) and bp and the associated context to the same.
- 1.2 In attendance at ISH1 on behalf of bp were:
- 1.2.1 Catherine Howard, Partner at Herbert Smith Freehills LLP ("CH");
  - 1.2.2 Ben Tze Kek, Deputy Project Director at bp ("BTK"); and
  - 1.2.3 Maxwell Harrison, Commercial Developer at bp ("MH").
- 1.3 Where further information was requested by the Examining Authority ("ExA"), this has either been provided in this summary (or the referenced appendices to bp's Deadline 3 submission), or an update provided as to its intended submission date.

## 2. AGENDA ITEM 8 – PROTECTIVE PROVISIONS SUGGESTED BY ORSTED AND BP

- 2.1 In response to the ExA's queries regarding the context to the overlapping area of seabed between Hornsea 4 and the NEP Project (both as defined in [REP1-057](#)), CH clarified that:
- 2.1.1 the area of overlap between the Hornsea 4 DCO red line boundary and the Endurance Store (as defined in section 1.1 of bp's Deadline 1 submission (Appendix 2 of [REP1-057](#) (electronic page number 119)) totalled 110km<sup>2</sup>, and it is this area which represents the 'Exclusion Area' as defined in the protective provisions proposed by bp (Annex 3 of bp's Deadline 2 submissions – [REP2-062](#));
  - 2.1.2 the 'Notification Area' (also as defined in bp's protective provisions) is for a further area beyond the 'Exclusion Area' which then collectively total 130km<sup>2</sup>.
  - 2.1.3 National Grid Carbon (via its affiliate Carbon Sentinel Limited) was awarded the UK's first carbon storage licence (CS001) (the "Storage Licence") on 6 November 2012;
  - 2.1.4 the relevant Agreement for Lease for the area of seabed encompassing the Endurance Store was granted by The Crown Estate ("TCE") to National Grid Twenty Nine Limited on 14 February 2013 (the "Endurance AfL"); and
  - 2.1.5 bp, Carbon Sentinel Limited and Equinor New Energy Limited are the current licensees to the Storage Licence (from 1 October 2020), and bp is the named party to the Endurance AfL (from 10 February 2021).
- 2.2 In response to the ExA's query concerning the timings for the consenting of the offshore components of the NEP Project, BTK confirmed that it is presently anticipated that the necessary consent for the offshore component of the NEP project (involving the environmental impact assessment ("EIA")/ environmental statement ("ES") and storage permit application) will be submitted to BEIS (Offshore Petroleum Regulator for Environment and Decommissioning ("OPRED")) in September 2022 and to North Sea Transition Authority ("NSTA") (formerly the Oil and Gas Authority) in November 2022 respectively.
- 2.3 bp carried out an informal scoping consultation in respect of the proposed EIA for the offshore elements of the NEP project in September and October 2021. Orsted were consulted as part of this exercise and submitted their comments to bp in return.
- 2.4 BTK further confirmed bp anticipates that, once it submits the ES to OPRED as part of the application for approval in September 2022, a formal statutory public consultation will be

undertaken by OPRED in Q4 2022, with a final determination in relation to the EIA expected in approximately May 2023 and a decision on the storage permit in approximately June 2023.

- 2.5 bp have provided an explanatory note of the consenting process and the basis for the assumed timescales in Appendix 5 to its Deadline 3 submission. This confirms the reasonableness of the assumed timescales and so why they will not represent a delay to the overall programme.
- 2.6 In response to the ExA's queries concerning the assumed construction timings set out in section 5.3.1 of bp's Deadline 2 submissions ([REP2-062](#) (electronic page number 6)), BTK further confirmed that whilst the NEP project is a First of a Kind ("FOAK") project, the timings have been benchmarked based on comparator schemes and on the collective expertise and its consortium partners from the NEP project.
- 2.7 BTK noted that the assumed timescales are also consistent with published industry guidance and refers the ExA to the guidance notes published by the Oil and Gas Authority (the predecessor to the NSTA) titled "*Carbon Dioxide Appraisal and Storage Licensing and Permit Requirements*" and "*Carbon Dioxide storage permit application guidance*" included at Annexes 1 and 2 to Appendix 5 of bp's Deadline 3 submission.
- 2.8 The ExA queried whether over the lifetime of the operation of the Endurance Store there is the potential for heave. BTK noted that extensive geomechanical modelling has been carried out initially as part of the White Rose development and latterly by NEP in greater detail, with consequent seabed displacement expected to be minor and spread across a wide seabed area (the Endurance saline aquifer traces approximately 140 km<sup>2</sup> of equivalent seabed).
- 2.9 The ExA asked a number of queries concerning the role of the technical regulator in relation to the Endurance Store (noting the economic regulator is BEIS/Ofgem) and specifically sought to clarify the requirements around the associated monitoring obligations and bp's previous submissions in relation to the same.
- 2.10 It is understood the ExA's queries referred to bp's submissions at sections 5.3.1 and 5.4 of its Deadline 2 submission ([REP2-062](#) (electronic page numbers 6 and 7) and whether bp had any basis for confirming what the regulator (the NSTA) would accept/not accept in relation to those monitoring obligations and specifically the technology relied upon.
- 2.11 CH clarified that it was not bp's intention to suggest that the NSTA has formally determined the appropriateness or not of use of any specific monitoring technology in relation to the Endurance Store. That determination will only follow at the point of the decision in relation to the Store Permit application through the approval of the monitoring plan. As noted in the NSTA's guidance (see Annex 2 to Appendix 5 of bp's Deadline 3 submission), the choice of monitoring technology will be site specific and based on best practice available at the time of design.
- 2.12 Instead bp's submissions were intending to clarify the obligations imposed on bp (as operator) and the correlative principles that will inform the NSTA's decision, particularly the need to use best available technology ("BAvT").
- 2.13 BTK confirmed it was this underlying need to demonstrate use of BAvT which has informed bp's proposed development of the NEP project and the submissions made in the Hornsea 4 examination to date. bp explained in sections 7.4 to 7.7 of its Deadline 1 submission ([REP1-057](#) – Appendix 2 (electronic pages 128 and 129)), Section 7 of its Technical Report (Annex 1 to its Deadline 1 submission) why it considered 4D vessel towed streamer seismic acquisition to be the BAvT at this point in time.
- 2.14 In those same submissions, and separately in Section 5.3 of its Deadline 2 submissions ([REP2-062](#) (electronic page numbers 6 to 8)) why any alternative is not considered credible, either now, or in a timescale that could still enable the delivery of the ECC plan (as defined in section 2 of bp's Deadline 1 submission – [REP1-057](#) (electronic page number 120)). Whilst it is accepted that it is not possible to definitively confirm this point as

that is a matter for the NSTA, bp does not consider there to be any reasonable evidence to suggest a credible contrary alternative interpretation.

- 2.15 However, as discussed in section 5.7 of bp's Deadline 2 submission ([REP2-062](#) (electronic page number 8)), in circumstances where bp is incorrect in its submissions and a robust and reliable technical solution does come forward in unforeseen and unprecedented timescales, bp's protective provisions do not preclude the use of such technology. They are stated to apply unless otherwise agreed between the parties and so in circumstances where such a solution was to become available, then the provisions could be varied as necessary in view of the same.
- 2.16 The ExA queried whether it would be appropriate to provide for conditionality around the application of bp's protective provisions and invited bp to consider alternative drafting on a without prejudice basis, pending the ExA and Secretary of State's eventual decision on the matter. CH confirmed this would require further instruction; however, noted that the SoS may still wish to provide for the Exclusion Area and so the practical effect of bp's proposed protective provisions in circumstances where the NEP project did not proceed so as to safeguard the future ability to utilise the Endurance Store, whether by bp or alternative developers. This remains bp's primary position and so does not consider there to be appropriate alternative drafting; however, acknowledging the ExA's request, will consider the position further and update at Deadline 4.
- 2.17 The ExA queried the proposed disapplication of the Interface Agreement in bp's protective provisions (as advocated in Annex 2 of bp's Deadline 2 submission - [REP2-062](#)). CH reiterated bp's position that whilst the disapplication of an agreement between parties under a DCO is novel, Section 120(3) of the Planning Act 2008 is a broad power and enables the Secretary of State to include any provision "*relating to, or matters ancillary to, the development for which consent is granted*". CH noted bp accepts that it will be for bp to justify the need for the provision, but that the *vires* for its inclusion is clear.
- 2.18 It is noted that in response to the ExA's questions Orsted accepted the breadth of the power under s120(3) allowed for the potential inclusion of the provision, but did not accept that there was justification. bp notes the subsequent Rule 17 letter issued by the ExA dated 14 April 2022 which requested bp to put in its further submissions to justify the proposed disapplication of the Interface Agreement by Deadline 4; however, following TCE's confirmation they were content with the proposed disclosure of the Interface Agreement, bp has attached a copy of the IA, along with a summary of its terms and a fuller justification for its disapplication in Appendices 2 and 3 to its Deadline 3 submission.
- 2.19 In addition to those legal submissions, it is noted that Orsted made a number of assertions criticising the timing of and approach to the disapplication of the Interface Agreement. bp addressed these criticisms as part of its Deadline 2 submissions (section 4.6 of Annex 2 - [REP2-062](#) (electronic page number 18)) and does not repeat the same here to avoid duplication.

## APPENDIX 5

### LEGAL NOTE ON THE CONSENTING PROCESS FOR THE OFFSHORE COMPONENTS FOR NEP



## SUMMARY OF THE CONSENT AND APPROVAL PROCESSES FOR THE ENDURANCE STORE

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### 1. INTRODUCTION

#### 1.1 This note sets out:

- 1.1.1 The consenting processes relevant to the development of the Endurance Store, including expected timings;
- 1.1.2 The role of the North Sea Transition Authority ('NSTA', formerly the Oil and Gas Authority) in approving monitoring plans for the NEP project; and
- 1.1.3 The legal basis of the duty to use 'best available technology' or 'BAvT' for seismic monitoring.

### 2. THE STORAGE LICENCE

- 2.1 A 'storage licence' was granted for the Endurance Store in 2012, under s18 of the Energy Act 2008. bp is the operator of this licence (Licence CS001, the 'Licence') on behalf of the Northern Endurance Partnership partners (bp, Shell, TotalEnergies, Equinor and National Grid).

### 3. CONSENTS UNDER THE EIA REGULATIONS 2020

- 3.1 The Offshore Oil and Gas Exploration, Production, Unloading and Storage (Environmental Impact Assessment) Regulations 2020 ("EIA Regulations") is also applicable, as the project falls within Schedule 1, para 3, of the EIA Regulations.

- 3.2 For such projects the Secretary of State must 'agree to the grant of consent' by the NSTA, and then the NSTA must grant consent, before the project can be commenced (Reg 4(1)).

#### **Preparation of and Consultation on Environmental Statement**

- 3.3 The Secretary of State can only 'agree to the grant of consent' where an environmental impact assessment has been carried out (or where one is not required) (Reg 4(3)).

- 3.4 bp is currently in the process of preparing an offshore environmental statement ('ES') in support of NEP's development of the Endurance Store. Once the ES has been submitted to the Offshore Petroleum Regulator for Environment and Decommissioning ('OPRED') (who act on behalf of the Secretary of State), OPRED will issue a letter of acknowledgement which, amongst other things, will list relevant authorities likely to have an interest in the project. bp must serve a notice on each of these authorities confirming how representations should be made and the date they must be made by (which must be at least 30 days after the date on which the documents were served).

- 3.5 In addition, the letter of acknowledgment will confirm that a public notice must be published. The public notice must state a date not less than 30 days after the date on which the notice is last published by which any person may submit representations in relation to the project to the Secretary of State.

- 3.6 The Secretary of State may require the developer to provide further information following receipt of an ES. bp would be required to provide this information to OPRED.



- 3.7 If requested to do so, bp must also provide further information to the authorities that the ES was required to be served on, along with a notice referring to the previous material submitted and stating that further representations may be made to the Secretary of State by a specified date, which must be at least 30 days after the date on which the further information was served.
- 3.8 OPRED will notify bp if the further information is considered directly relevant to reaching a conclusion on whether the project is likely to have a significant effect on the environment, in which case, the information must be made publicly available. If further information is requested, that information would need to be prepared and time may need to be allowed for authorities to make representations.

#### **OPRED 'agreement to the grant of consent'**

- 3.9 OPRED (on behalf of the Secretary of State) will reach its conclusion on the significant effects of the project on the environment once issues raised during the consultation period or OPRED's review have been resolved. If OPRED agrees to the grant of consent, it will issue a letter to bp advising of any conditions and decision requirements and will also notify the NSTA of OPRED's agreement to the grant of consent.
- 3.10 There is no statutory timescale for OPRED to agree to the grant of consent, but the EIA Regulations note the decision must be made within a "*reasonable time*" from the receipt of information and representations "*taking into account the nature and complexity of the project*" (Reg 14(6)).

#### **NSTA grant of consent**

- 3.11 The NSTA will then decide whether to grant consent pursuant to the EIA Regulations for the project to commence. The EIA Regulations state that the NSTA must "*decide whether to grant consent within a reasonable time following the Secretary of State's decision on whether to agree to the grant of consent*" (Reg 15(1)). When the NSTA is prepared to make its decision, OPRED will consider whether the conclusions are up-to-date or whether there is any new information which would need to be consulted on.
- 3.12 Once finalised, OPRED's and the NSTA's decision would be published on the Government's website, along with the website address where information regarding the environmental statement consultation and the decision can be obtained. The decision notice would also be copied to the authorities consulted on in the Environmental Impact Assessment process.

#### **4. THE STORAGE PERMIT**

- 4.1 In addition to the storage licence and consent under the EIA Regulations, a 'storage permit' is required to authorise storage of Co2 in the Endurance Store. The Licence states that a store permit application must be made in accordance with the Storage of Carbon Dioxide (Licensing) Regulations 2010 ("**Storage Regulations**"). Once granted, the storage permit is treated as part of the Licence.
- 4.2 Guidance published by the Oil and Gas Authority (now the NSTA) entitled 'Carbon Dioxide Appraisal and Storage Licensing and Permit requirements' (**see Annex 1 of this note**) suggests that the process of obtaining a store permit (including the time taken to obtain consent under the EIA Regulations) is likely to be 'at least 6 months':

The assessment and approval of exploration activities is well preceded in the oil and gas context, but approval of the Storage Permit application is a novel and unprecedented regulatory process. Its duration is correspondingly uncertain, but seems likely to take at least 6 months. However, this would be dependent on the complexity of the development and the need to resolve any issues that may arise. The estimate for the storage permit includes an estimated time for the environmental impact assessment that will be required under the terms of the Offshore Petroleum Production and





Pipelines (Assessment of Environmental Effects) Regulations 1999<sup>1</sup> which have been amended to specifically cover carbon storage activities. However it should be noted that appropriate assessments may also be required of the implications of the grant of a storage permit on a SAC or SPA.

## 5. TIMING OF BP'S APPLICATIONS

5.1 As stated in bp's previous submissions, bp intends to:

5.1.1 Submit its ES to OPRED in September 2022; and

5.1.2 Make its application for a store permit to the NSTA in November 2022.

5.2 bp anticipates that this will result in formal statutory public consultation by OPRED in Q4 2022, with final determination under the EIA Regulations in approximately May 2023, and a decision on the storage permit in approximately June 2023.

5.3 This programme assumes more than the minimum six month timescale set out in the Oil and Gas Authority guidance referred to above.

5.4 It also aligns with the statutory timescales for a decision on the Net Zero Teesside DCO, which begins examination in May 2022, and therefore is expected to be decided by the Secretary of State by May 2023.

## 6. APPROVAL OF MONITORING PLANS UNDER THE STORE PERMIT

### Monitoring Plan

6.1 A monitoring plan must be submitted for approval with the store permit application, but must also be updated in various circumstances. The relevant Regulations are set out below.

6.2 Reg 7(1) of the Storage Regulations requires that "Before granting a storage permit the [NSTA] must be satisfied that: (a) the storage complex and surrounding area have been sufficiently characterised [...] (c) under the proposed conditions of use of the storage site, there is no significant risk of leakage or of harm to the environment or human health".

6.3 Reg 7(5) authorises the NSTA to approve an applicant proposed monitoring plan or 'require the applicant to make such modifications to it as the authority (after consulting the applicant) considers necessary"

6.4 Reg 8 requires that the store permit must include the provisions set out in Schedule 2 relating to monitoring which are as follows:

### 2.— Monitoring

(1) The operator must carry out a programme of monitoring of the storage complex and injection facilities, for the purposes specified in sub-paragraph (3).

(2) Such monitoring must include (where possible) the monitoring of the CO<sub>2</sub> plume, and (where appropriate) of the surrounding environment.

(3) The purposes are—

(a) the comparison of the actual and modelled behaviour of the CO<sub>2</sub> (and the naturally-occurring formation water) in the storage site;

(b) the detection of any significant irregularities;

(c) the detection of any migration of CO<sub>2</sub>

<sup>1</sup> Now The Offshore Oil and Gas Exploration, Production, Unloading and Storage (environmental Impact Assessment) Regulations 2020



- (d) the detection of any leakage of CO<sub>2</sub>
  - (e) the detection of any significant adverse effects on the surrounding environment, and in particular on—
    - (i) drinking water,
    - (ii) human populations, and
    - (iii) users of the surrounding biosphere;
  - (f) the assessment of the effectiveness of any corrective measures taken;
  - (g) updating the assessment of the safety and integrity, both short- and long-term, of the storage complex (including the assessment of whether the stored CO<sub>2</sub> will be completely and permanently contained).
- (4) The monitoring must be based on the monitoring plan<sup>2</sup>
- (5) The monitoring plan must be updated in accordance with Annex II to the Directive, and in any event within five years of the approval of the original plan, in order to take account of—
- (a) changes to the assessed risk of leakage;
  - (b) changes to the assessed risks to the environment and human health;
  - (c) new scientific knowledge; and
  - (d) improvements in best available technology.
- (6) The updated plan must be submitted for approval by the authority.
- (7) The authority may—
- (a) approve that plan, or
  - (b) require the operator to make such modifications to it as the authority (after consulting the operator) considers necessary, and the updated monitoring plan is the plan as so approved or modified.
- (8) Sub-paragraphs (5) to (7) apply to the further updating of an updated plan as they apply to the updating of the original plan.

6.5 There are also positive duties on the NSTA under Reg 11 to consider whether to modify or revoke the storage permit, among other things where 'any scientific finding or technological development [...] appear to have a bearing on the conduct of operations'.

## 7. BEST AVAILABLE TECHNOLOGY – AN ONGOING DUTY

7.1 As can be seen above, the Storage Regulations expressly require that the store permit is granted with a condition requiring use of 'best available technology' (Schedule 2, para 2(5)(d)) and that there is an ongoing duty during the lifetime of the store<sup>3</sup> to update the monitoring plan to ensure that monitoring is carried out in the most appropriate way given: "(a) changes to the assessed risk of leakage;(b) changes to the assessed risks to the environment and human health;(c) new scientific knowledge; and (d) improvements in best available technology".

7.2 As bp clarified at ISH1, there is no list published by the NSTA of what constitutes 'best available technology'. Instead, the onus is on the applicant at the point of application for the store permit, and on an ongoing basis thereafter, to show that the technology they propose to use is the 'best available'.

7.3 There is some guidance provided by the Oil and Gas Authority, in Appendix 2 of the document entitled 'Carbon Dioxide storage permit application guidance' (see **Annex 2 to this note**) which emphasises that there must be 'justification for technology choice' for each phase, and that "The choice of monitoring technology will be site specific and based on best

<sup>2</sup> Defined as the monitoring plan approved when the store permit was granted.

<sup>3</sup> And post-closure pursuant to paragraph 4 of Schedule 1 to the Storage Regulations.



practice available at the time of design'. It goes on to state that: 'The nature of the monitoring will be site specific and informed by the findings of the site characterisation and risk assessment and dependent on the size and type of storage structure (e.g. depleted hydrocarbon field, deep saline formation). The justification for not deploying specific techniques should be documented.'" Section 2.3 of Appendix 2 in that guidance document (Annex 2 to this note) states in relation to 'Updating the plan':

### **2.3 Updating the plan**

The data collected from the monitoring activities shall be collated and interpreted. The observed results shall be compared with the predicted behaviour in the dynamic simulation of the 3-D-pressure-volume. Where there is a significant deviation between the observed and the predicted behaviour, the 3-D-model shall be recalibrated to reflect the observed behaviour. The recalibration shall be based on the data observations from the monitoring plan, and where necessary to provide confidence in the recalibration assumptions, additional data shall be obtained. Data shall also be used to revise and update the risk assessment.

Where new CO<sub>2</sub> sources, pathways and flux rates or observed significant deviations from previous assessments are identified as a result of history matching and model recalibration, the monitoring plan shall be updated accordingly.

The yearly report to the competent authorities should encompass the above. If needed comment on site-specific monitoring problems.

7.4 As explained in bp's submissions at deadline 1 and 2, bp is firmly of the view that 4D towed streamers constitute 'best available technology' and that this will remain the position by the date of the Final Investment Decision on the project (in May 2023) (in order to start construction and enable CO<sub>2</sub> injection to commence from 2026 as required by the ECC plan). Indeed, the type of monitoring will form part of the store permit application (through the submission of the monitoring plan) which is being submitted in November 2022.

7.5 bp clarified at ISH1 that it was not bp's intention to suggest in its previous submissions that the NSTA has formally determined the appropriateness or not of any specific monitoring technology in relation to the Endurance Store (in response to the ExA's queries concerning previous submissions, understood to relate to paragraphs 5.3.1 and 5.4 of bp's Deadline 2 submission ([REP2-062](#) (electronic page numbers 6 and 7)). That determination will only follow at the point of the decision in relation to the Store Permit application through the approval of the monitoring plan.

## **8. THE HYBRID SOLUTION – NOT BEST AVAILABLE TECHNOLOGY CURRENTLY**

8.1 Ocean bottom nodes are an available technology, as are shorter towed streamers. But the question is whether this hybrid solution constitutes the 'best available technology' to monitor the Endurance Store. Even the Applicant in para 5.3.1 of its deadline 2 submission states: "*The Applicant acknowledges that neither the NEP Overlap Report [bp's technical report] nor the OREC Co-location Review [commissioned by Orsted] offer a clear and final solution for the technical considerations and uncertainties of the endurance development, but that is not to say a solution will not be found in the future*".

8.2 It is important to note that in assessing what is 'best available technology', the NSTA will not be able to take account of the fact that bp's options are limited by the existence of the windfarm above part of Endurance, and therefore accept a lower standard of imaging. The



NSTA will expect the best possible image quality, particularly given that this is a first of a kind project.

- 8.3 For the ExA's information, while Appendix 2 of the Guidance (Annex 2 to this note) does refer to use of 'ocean bottom cables' as a possible technology, these are different from ocean bottom nodes – being nodes attached and powered through a cable rather than individual nodes powered by batteries. In any event, the site conditions of the Endurance Store mean that ocean bottom cables would suffer from the same seabed tidal movements as ocean bottom nodes, so they are also not comparable in quality and definition of image to vessel towed streamer seismic data.

## 9. **NO CERTAINTY THAT THE HYBRID SOLUTION WILL EVER BE APPROPRIATE**

- 9.1 The Applicant has also suggested that while the hybrid solution might not be acceptable to the NSTA immediately, it might be possible to monitor initially using 4D towed streamers, up until the point when the wind farm infrastructure is installed, and from that point onward to switch to the hybrid solution or some alternative new technology.

- 9.2 There are fundamental conceptual difficulties with this suggestion.

- 9.3 bp acknowledges that in principle, and with the passage of time, it is possible that it is possible that there might be new technologies available which provide seismic imaging for Endurance of the same quality as that created by repeated 3D towed streamer acquisition over time (known as time lapse or 4D monitoring). This would require such technologies not just to have been developed but to have been shown to be as good as 3D towed streamers after deployment in an operational setting elsewhere for a number of years. In principle, bp could if it determined it was appropriate to do so then approach the NSTA and seek to get approval of a monitoring plan using those techniques. However, there is no certainty when (if ever) such proven techniques will be available. bp believe this would not be likely for ten to twenty years at least.

- 9.4 bp also acknowledges that if bp carries out 4D towed streamer monitoring of Endurance for a number of years, it may be able to demonstrate that the CO<sub>2</sub> injected is behaving as expected - settling as expected within the formation, and without leaks or compartmentalisation. In principle, this could enable bp to seek approval from NSTA for a less high definition monitoring technique like the hybrid solution. However, even if such a solution were approved by the NSTA in the future, there is always the possibility that further monitoring then shows that the storage of CO<sub>2</sub> is not behaving as expected, or other risks are identified, which mean that the NSTA then requires bp to once again employ 4D towed streamer monitoring, being the highest-definition imaging solution available for a structure such as Endurance. If Hornsea Project Four infrastructure has been located in the area of overlap between the projects by that time, this will not be possible. This could ultimately lead to NEP having its storage permit revoked by the NSTA, as it has the power to do under the Storage Regulations.

## 10. **ACCESS ISSUES**

- 10.1 While this note focuses on the acceptability or otherwise of monitoring techniques, it is equally important to note that the NSTA will also be required to approve all other operational matters in granting the store permit. This will include the need to assure the NSTA that access for relief well, helicopter and drilling is adequately and safely catered for in the area of overlap between Endurance and Hornsea Project Four. For the reasons set out in bp's deadline 1 submission (sections 7.8 to 7.9 and 8.9 ([REP1-057](#)) – Appendix 2 (Electronic Page numbers 129, 130, 132 and 133) bp does not believe it could make the case successfully that such operational arrangements meet the necessary standards to be approved by NSTA.



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**ANNEX 1: 'Carbon Dioxide Appraisal and Storage Licensing and Permit requirements'**



## Carbon Dioxide Appraisal and Storage Licensing and Permit Requirements

This note provides guidance on the process for obtaining a Carbon Dioxide and Storage Licence and Storage Permit from OGA, and gives indicative timings for regulatory decisions to be made in relation to such licences and permits. It is not intended to provide comprehensive guidance on the regulatory requirements arising out of CCS activities, and any company which is considering engaging in such CCS activities will need to take their own advice on the specific regulatory requirements of their proposal.

Although the physical granting of a Licence could be a relatively speedy process it will be necessary, in compliance with the requirements of the Habitats and Birds Directives (under the Offshore Petroleum Activities (Conservation of Habitats) Regulations 2001) to give consideration to the effect of any grant of a Licence at the proposed storage site location on any designated, or proposed, "Special Area of Conservation" (SAC) or "Special Protection Area" (SPA).

If the Secretary of State does not consider it likely that there will be an effect on a SAC or SPA, then the SEA process would be completed in relation to the relevant licence application, and OGA could grant a Licence **within perhaps a month of application**. However, if it is considered that there may be an effect on a SAC or SPA then an assessment of that potential effect and its implications for the integrity of the site and the designated features and species will have to be made, including a three month consultation. This might then take the period from application to grant of a licence (if granted) to **approximately 6 months from application**.

Only once the licence is granted and any specific consents or approvals that are required have been obtained can the relevant activities proceed. These activities may include appraisal work requiring an "Exploration Permit", within the meaning of the Directive, leading to an application for the "Storage Permit", or you may be in a position to proceed directly to the submission of the application for the Storage Permit.

The assessment and approval of exploration activities is well precedented in the oil and gas context, but approval of the Storage Permit application is a novel and unprecedented regulatory process. Its duration is correspondingly uncertain, but seems likely to take **at least 6 months**. However, this would be dependent on the complexity of the development and the need to resolve any issues that may arise. The estimate for the storage permit includes an estimated time for the environmental impact assessment that will be required under the terms of the Offshore Petroleum Production and Pipelines (Assessment of Environmental Effects) Regulations 1999 which have been amended to specifically cover carbon storage activities. However it should be noted that appropriate assessments may also be required of the implications of the grant of a storage permit on a SAC or SPA.

As required by Article 10 of Directive 2009/31/EC, OGA must make applications for a storage permit available to the Commission within one month after receiving them, and must also provide the Commission with a draft of any storage permit that OGA is minded to grant.

**Within four months of receiving** the draft storage permit, the Commission may issue a non-binding opinion on it. If the Commission decides not to issue an opinion, it shall inform OGA within **one month** of submission of the draft permit and state its reasons. OGA must consider any opinion issued by the Commission before granting the Storage Permit.

After the above has been completed, OGA would be in a position to reach a decision on whether to grant the Storage Permit.

All of these OGA timings are of course indicative at this stage – the OGA should be consulted if any more detail is required.



HERBERT  
SMITH  
FREEHILLS

**ANNEX 2: 'Carbon Dioxide storage permit application guidance'**





## Carbon dioxide storage permit application guidance

### 1. Site Selection and Characterisation of the Geological Storage Site and Complex.

The guidance provided here describes the technical information required to make a detailed analysis of the efficacy of a storage site and storage complex. By acquiring all the requisite data, a thorough site characterisation and understanding the storage complex and hydraulic unit should be possible. The analysis is intended to identify the potential risks that may cause leakage from the storage complex. The risks identified as a result of the characterisation will provide the essential input to the risk assessment, the monitoring plan and the corrective measures plan.

#### 1.1 Geological Interpretation and Structural Configuration

This step is required to describe the overall shape and size of the proposed geological formation for CO<sub>2</sub> storage and the sealing mechanism that will keep the CO<sub>2</sub> stored permanently (i.e. site *and* complex)..

The following minimum basic information is likely to be required to build a reliable geological model of the proposed storage site.

##### 1.1.1 Seismic Database

High quality seismic data that properly images the storage site, storage complex and the connecting area is required. Seismic surveys that were designed to image specific geological horizons for hydrocarbons may not be suitable for the accurate imaging and characterisation of a proposed CO<sub>2</sub> storage formation if the depth of interest is significantly different. To make a detailed evaluation and delineation of the storage site and complex, recent high quality seismic data is required as a baseline survey. Consideration needs to be given to the repeatability of the baseline survey if time lapse monitoring is required in the future. Away from the storage site and storage complex, good quality 2D seismic data may be considered adequate for more regional mapping, particularly for deep saline formations.

##### 1.1.2 Geological Horizon Mapping

This section should detail the well database and how the well information has been integrated with the seismic data. It should include a description of the

storage site and storage complex stratigraphy, facies variations, the geological correlation within the primary geological formation, caprock and potential secondary geological formations and associated caprocks. Figures and maps should be provided where appropriate.

### **1.1.3 Depth Conversion**

An explanation of the depth conversion methodology and data used to derive the methodology.

### **1.1.4 Structural Configuration and Faulting**

A description of the structural history and structural configuration of the storage site and storage complex, and any potential compartmentalisation should be provided. Assessment of small and large scale faults, their sealing capability and potential leakage pathways should be included.

### **1.1.5 Hydraulic Communication between Geological Units**

This section should discuss the interaction with other parts of the storage site and complex that are in hydraulic communication. This is particularly important to identify any impacts on other usage of the geological formation such as hydrocarbon extraction or other CO<sub>2</sub> storage sites. A thorough understanding of the regional geology is required

## **1.2 Geological Storage Site and Storage Complex**

### **1.2.1 Geological Storage Site**

Description of the primary and any secondary storage horizons: correlation of units within those units; identification of any impermeable baffles or barriers.

### **1.2.2 Caprock**

Description of the sealing capacity and capillary entry pressure of the primary caprock to the storage site and any secondary caprocks.

## **1.3 Rock and Fluid Properties**

This step is required to take account of data gathered from pre-existing wells and proposed appraisal wells, such as wireline well logs and core and reservoir fluid samples, in informing the geological model. Data also needs to be gathered to enable modelling of the likely interaction between the injected CO<sub>2</sub>, the geological formation and the existing fluids.

### **1.3.1 Core and Well Logging Analysis – Porosity and Permeability Estimation**

The proposed wireline well logging programme to gather basic information on the rock properties such as the porosity-permeability correlation. Core samples should be analysed to gather information on rock properties across the geological zone of interest.

### **1.3.2 Formation Pressure and Temperature Gradient Analysis**

Information on the reservoir pressure and temperature regime are needed to predict the phase behaviour of injected CO<sub>2</sub> within the storage site. This may be particularly important where CO<sub>2</sub> is to be injected into depleted gas

reservoirs, which may initially be at extremely low pressures, and for Enhanced Oil Recovery (EOR) projects in oil fields where the extra oil recovery is usually highly dependent on the injected CO<sub>2</sub> achieving miscibility with reservoir oil.

### **1.3.3 Geomechanics and Fracture Pressure analysis**

There is a risk that injecting CO<sub>2</sub> at too high a rate or pressure could lead to unplanned fracturing of the rock, which in the worst case could also fracture the cap-rock. It is therefore very important to carry out a thorough analysis of the geomechanics of the geological formation to determine safe thresholds for CO<sub>2</sub> injection rates.

The reservoir stress history from previous production should be reviewed for depleted gas reservoirs to ascertain the risks of irreversible damage to the reservoir rock from previous pressure depletion. This is likely to be a more significant factor in highly depleted gas reservoirs.

### **1.3.4 Geochemistry - Interaction of CO<sub>2</sub> in the storage site**

CO<sub>2</sub> injection generally introduces a new fluid type into the storage site and this presents the risk of unexpected interactions between the injected CO<sub>2</sub> and both the rock matrix and reservoir fluids. This could include precipitating out minerals from the geological formation which block pore-throats and thus reduce CO<sub>2</sub> injectivity, or the possibility of hydrate formation if injected CO<sub>2</sub> expands very rapidly in a pressure depleted gas reservoir. The expected behaviour needs to be analysed (e.g through a programme of core experiments at reservoir conditions) and the operator should demonstrate how the risks to injectivity are going to be managed.

### **1.3.5 Formation Fluid PVT Analysis - Phase behaviour of injected CO<sub>2</sub>**

The predicted envelope of likely thermodynamic phase behaviour of injected CO<sub>2</sub> within the storage site. This may be particularly important for modelling the expected behaviour of EOR projects in oil fields where there is often a complex phase interaction when injected CO<sub>2</sub> contacts bypassed oil.

### **1.3.6 Relative Permeability Analysis and Capillary Pressure**

Relative permeabilities are used to describe how the flow capacity of a fluid (such as CO<sub>2</sub>) is impeded by the presence of other fluids (e.g. water or gas). Related to this are the residual saturations which describe how much of one fluid is left behind trapped at the pore scale as it is displaced by another fluid. CO<sub>2</sub> pushes out water as it is injected into a deep saline formation, but some water is left trapped within the pore spaces of the rock (the irreducible water saturation) as the CO<sub>2</sub> flood front passes through. The residual saturations can have a significant impact on the overall CO<sub>2</sub> storage capacity. Relative permeability and residual saturations are normally measured from laboratory flooding tests on rock cores taken from the storage site.

Capillary pressure analysis is required to estimate the capillary entry pressure of CO<sub>2</sub> into the caprock which may have implications for the maximum acceptable pressure during storage operations.

## **1.4 Estimating the CO<sub>2</sub> Storage Capacity**

The data gathered above can be used to construct a static 3D geological model of the proposed storage site and complex, which maps the overall distribution of pore space available for CO<sub>2</sub> storage and which includes the cap-rock and surrounding hydraulically connected areas.

### **1.4.1 Deterministic and Probabilistic Volumetric calculation of pore space**

The overall pore space in the reservoir should be summed to give a probabilistic estimate (e.g. P10, P50 and P90 confidence values) of the total pore space capacity available. The uncertainties in each of the major parameters used to construct the geological model should be analysed individually and each parameter should be assigned a probabilistic range of outcomes. The major overall uncertainties in the final geological model should also be ranked and assessed in order of importance.

### **1.4.2 Determination of Actual CO<sub>2</sub> Storage Capacity**

A probabilistic estimate of the actual CO<sub>2</sub> storage capacity of the storage site should be calculated by combining the pore space capacity estimates with the residual fluid saturations and CO<sub>2</sub> PVT behaviour. In the case of storage in depleted gas and oil reservoirs the calculation may be complicated by the need to understand the current distribution of oil, gas and water within the reservoir.

The storage capacity calculated here will be a theoretical maximum. In the case of saline aquifers, for example, the practical storage capacity will be highly dependent on how easy it is for the injected CO<sub>2</sub> to displace the water that currently occupies the pore space. Water is a relatively incompressible fluid and the pressure around the injector may build up quickly to maximum allowed values if low reservoir permeability or unexpected fault compartmentalisation impedes pore water movement.

## **1.5 Reservoir Engineering**

This section describes a requirement to simulate how the formation pressure and fluid distributions will behave when CO<sub>2</sub> injection commences. A good reservoir engineering understanding of the storage site will enable accurate prediction of factors like required injection well numbers, impact of compartmentalisation on effective storage capacity, and likely additional oil recovery from an EOR scheme.

The normal approach is to use the static geological model, plus dynamic data from well testing, to construct a reservoir simulation model. This can then be used in the permit application to predict overall reservoir flow and pressure behaviour, though it will be important that the model is first calibrated with baseline data from the storage site to provide a reference point before operations commence. Thereafter, the simulation model will need to be periodically conditioned (“history matched”) to the actual behaviour of the storage site as CO<sub>2</sub> injection proceeds to refine its predictive capability. Existing oil and gas reservoirs will almost certainly have existing simulation

models, although these may need updating to accurately model CO<sub>2</sub> injection, particularly when EOR projects are proposed. Potential deep saline formations as storage sites will normally require a reservoir simulation model to be built from scratch.

### **1.5.1 Review of Existing Well Data**

Many planned storage sites will already have existing well penetrations, particularly depleted hydrocarbon reservoirs. Existing well data should be reviewed to inform the geological model and the condition of suspended and abandoned wells should be analysed to assess the integrity of the wells and the risks of leakage. CO<sub>2</sub> is known to corrode cement under some conditions and the robustness of the cement seals in abandoned wells should be assessed. Seals, plugs and casing should also be assessed.

### **1.5.2 Appraisal Well Testing Programme**

Existing depleted gas and oil reservoirs in the North Sea will generally have extensive well testing and production data available and the reservoir limits and overall pressure behaviour are likely to be well understood. In these cases it may be appropriate to concentrate further appraisal well testing on CO<sub>2</sub> injectivity to provide assurance that CO<sub>2</sub> can be injected in the required quantities. In the specific case of CO<sub>2</sub> injection into highly depleted gas reservoirs there is a concern that rapid Joule-Thompson expansion of injected CO<sub>2</sub> close to the wellbore could lead to problems such as hydrate formation. This could cause severe impairment in CO<sub>2</sub> injectivity and needs to be taken into account by operators of CO<sub>2</sub> storage sites.

Deep saline formations will require more extensive appraisal well testing including pressure testing to determine its limitations (such as the effects of fault compartmentalisation) and overall permeability. Dynamic testing using multiple wells can help build up understanding of overall geological communication in larger structures and provide additional confidence of the potential to inject large quantities of CO<sub>2</sub> into a given structure. Pressure observation wells may also provide valuable information on potential leakage from the site following CO<sub>2</sub> injection tests.

Deep saline formations pose a significant practical difficulty in that it is very rarely possible to prove prior to a storage project commencing that the structure will provide a permanent pressure seal for injected gas. The very presence of oil and gas accumulations in hydrocarbon reservoirs shows that these structures have a pre-existing proven seal (otherwise the hydrocarbons would have escaped and been displaced by water over geological time), there is no such assurance for deep saline formations.

It is likely to take many years of careful monitoring and testing to gain confidence that a given deep saline formation will provide a reliable long-term store for CO<sub>2</sub> which may be a significant concern for operators relying on deep saline formation storage. One option to mitigate this risk is for operators to have a back-up storage facility available (e.g. in a suitable depleted gas reservoir) so that they can switch CO<sub>2</sub> injection into this if the deep saline formation store runs into problems. A risk mitigation strategy might be to

start the injection project using a depleted gas field as the main store and, simultaneously, start long term storage testing of an deep saline formation that can be accessed from the same injection facilities. This will enable the developer to build up confidence in the storage potential of the deep saline formation, while relying on a lower risk injection site for the bulk of early CO<sub>2</sub> storage requirements. As confidence in the deep saline formation as a safe receptacle for CO<sub>2</sub> increases with time, more injection can be switched from the depleted gas field to the deep saline formation.

### **1.5.3 Construction of Dynamic Simulation Model**

The 3D static geological model should be combined with the PVT data, dynamic pressure and flow data from appraisal well testing to construct a 3D dynamic simulation model for the proposed storage site and the surrounding storage complex. The simulation model is a digitised computer model of the storage site which can be used to predict the detailed changes in pressure and fluid distributions throughout the formation as CO<sub>2</sub> injection proceeds and to model the expected behaviour of new wells.

Any simulation model is just one mathematical representation of the properties of the storage complex and associated wells based on a limited set of geological and reservoir engineering data. It is prudent to run some sensitivity cases, varying the main parameters, to evaluate the robustness of the simulation calculations.

The ability of the simulator to model the expected thermodynamic and phase behaviour of injected CO<sub>2</sub> in the wellbore and geological formation should be demonstrated. In the case of CO<sub>2</sub> injection into some of the highly depleted gas reservoirs in the North Sea there may be complications due to very high pressure drops between the wellhead and the reservoir formation face. In the case of Enhanced Oil Recovery Projects (EOR) it may be necessary to use a specialised compositional simulator to adequately model the swelling of bypassed oil contacted by injected CO<sub>2</sub>.

As CO<sub>2</sub> is being introduced as a new fluid into the formation it will be important to demonstrate that the simulation model adequately reflects the expected geochemical and geomechanical interaction with existing reservoir fluids and rock (e.g. potential near wellbore rock dissolution, or chemical deposition).

## **1.6 CO<sub>2</sub> Storage Site Development Plan**

### **1.6.1 Injection wells**

The CO<sub>2</sub> Storage Development Plan describes the drilling schedule (number and proposed location of CO<sub>2</sub> injection wells, well completion strategy and formation interval to be perforated), proposed CO<sub>2</sub> injection schedule (total injection rates and distribution between injection wells), match up with surface and subsurface facilities).

### **1.6.2 Dynamic simulation model**

The dynamic simulation model should be used to demonstrate the expected response of the CO<sub>2</sub> storage site and storage complex to this development plan and in particular the pressure response within the geological formation and any surrounding hydraulically connected units and the predicted movement of the injected CO<sub>2</sub> plume. Consideration should be given to the maximum allowable injection pressure within the reservoir to avoid unanticipated fracturing of the rock formation.

The Development Plan should specify the number wells required for injection and any redundancy for remediation purposes.

The CO<sub>2</sub> storage development plan needs to be robust so that it can cope with unexpected outcomes, for example sudden drops in well injectivity

## **1.7 Potential CO<sub>2</sub> source(s)**

### **1.7.1 Estimates of the total potential mass of CO<sub>2</sub> available and point of origin.**

#### **1.7.2 Composition of the CO<sub>2</sub> stream**

The injected CO<sub>2</sub> stream shall consist overwhelmingly of carbon dioxide. No other waste matter may be added for the purpose of disposal of that waste substance. However the CO<sub>2</sub> stream may contain incidental associated substances from the source, capture or injection processes and trace substances may be added to assist in monitoring CO<sub>2</sub> migration. Concentrations of all incidental and added substances shall be below levels that would adversely affect the integrity of the storage site or the relevant transport infrastructure.

A risk assessment must be carried out to ensure that any contamination levels comply with the above conditions. The risk assessment should also identify any significant irregularities that may occur in the injection or storage operations or in the condition of the complex itself, which could lead to a risk of leakage or risk to environment.

## **1.8 CO<sub>2</sub> Transportation and Injection Facilities**

### **1.8.1 Pipeline and facilities.**

A description of the proposed pipelines and facilities (platforms, topsides and/or subsea facilities) should be included, with the main and standby capacities of major utility and standby systems identified together with the limitations and restrictions on operation. The control systems whether onshore or offshore should be described and where appropriate, offshore and onshore manning requirements should also be addressed.

The quality of the injected gas may vary during the life of injection cycle and it is important that ranges are established for the main chemical and physical parameters. Recognising that the Development Plan may include use of existing pipelines and associated facilities it will be important to describe the

expected performance of the as-built facilities in relation to the full range of gas described by the proposed gas specification envelope. This description should include the particular issues associated with corrosion, chemical reactivity (including gas adsorption characteristics of the various polymeric components) and pressure/temperature behaviours associated with any pressure breaks and/or gas phase transformations. The analysis should address the full life cycle of the field and should identify the range and impact of variations in flow rates, operating pressures and changes in the physical characteristics of the gas as the field moves through the life injection cycle.

### **1.8.2 Transportation network**

The section should describe the pipeline(s) or other method of transporting the CO<sub>2</sub> to the storage site. For pipelines the following information is required:

- Pipeline diameter
- Operating parameters
- Metallurgy

### **1.8.3 Injection Wells**

The design of the CO<sub>2</sub> injection wells is of paramount importance in ensuring the long term security of the storage site. Well paths are recognised to be the most likely leakage pathways if the design and construction has not been properly assessed and executed. The wells must be designed and constructed to meet the potentially challenging operating conditions imposed by a CO<sub>2</sub> stream and address any well failure scenarios.

The well design need to take account of the following operating conditions:

- Maximum anticipated injection pressures
- Maximum injection rates
- Temperature of the injected CO<sub>2</sub>
- composition and properties of the CO<sub>2</sub>
- injection volumes

#### **1.8.3.1 Wellhead**

In addition to the listed operating conditions above the wellhead design should take account of corrosion, erosion and seal integrity and compatibility with the injected CO<sub>2</sub>. The effects of erosion and corrosion of the injected CO<sub>2</sub> on the wellhead valve configuration, control and operation should be addressed.

#### **1.8.3.2 Tubing, casing and seals**

Additionally, the effects of expansion and contraction of the tubing due to thermal cycling should be considered in the choice of materials to be deployed, along with the effects of erosion and corrosion of the injected fluids.

Integrity of casing strings and the quality of the cement bonds are critically important in providing the necessary permanent seal to potential leakage conduits in the well bore. Consideration needs to be given to the type of cement used to ensure compatibility with the CO<sub>2</sub> particularly where CO<sub>2</sub> is likely to come into contact with formation water.



In order to confirm the seal integrity of the cement bonds, calliper logs and cement bond logs will be required.

#### **1.8.3.3 Well completion**

Completion of the well at the site of injection needs to take account of the formation properties in case sand control is required, such as slotted liners, sand screens or gravel packs. The well completion must not compromise the injection performance.

### **1.9 Seismicity**

Regional tectonic activity and seismicity needs to be assessed to ensure that there is no potential risk to the integrity of the storage site and complex.

### **1.10 Other activities in the surrounding area**

Consideration needs to be given to any potential interaction of CO<sub>2</sub> storage activities with oil and gas operations, or other CO<sub>2</sub> storage sites in the same hydraulic unit. In the case of the latter, it must be demonstrated that the potential pressure interactions between the sites will not prevent either from meeting the requirements of the Directive. This will inevitably require co-operation between the respective licensees of the sites.

If DECC considers the interaction of a CO<sub>2</sub> storage operation poses a significant threat to the overall security and integrity of any other activity in the vicinity or neighbouring area then the proposed plan will be rejected.

## Appendix 2

### 2. Monitoring Plan

Monitoring is necessary to establish an environmental baseline and to assess whether injected CO<sub>2</sub> is behaving as expected, and to detect if any unexpected migration or leakage occurs.

The monitoring plan should describe the monitoring activities to be undertaken by the licensees of the storage site. Subject to the conclusions of the site characterisation and risk assessment, this plan must include the monitoring of the injection facilities, the storage complex, including where possible the CO<sub>2</sub> plume and where appropriate the surrounding environment.

The following shall be specified for each phase of the storage operation:

- Parameters monitored;
- Monitoring technology employed and justification for technology choice;
- Monitoring locations and spatial sampling rationale;
- Frequency of application and temporal sampling rationale.

The choice of monitoring technology will be site specific and based on best practice available at the time of design.

#### 2.1 Storage Site and Storage Complex Monitoring Plan

A comprehensive monitoring plan forms an essential component of any proposed CO<sub>2</sub> Storage Permit. The purpose of the monitoring plan is to give assurance that the storage site is behaving as expected as CO<sub>2</sub> injection proceeds and in particular that the CO<sub>2</sub> remains safely trapped. Feedback from the monitoring plan is also invaluable in history-matching the dynamic simulation model so that it more accurately predicts future behaviour of CO<sub>2</sub> in the storage site and storage complex..

The initial monitoring plan should describe the types of monitoring to be deployed throughout the project, including baseline, operational and post-closure. The nature of the monitoring plan will be site specific, informed by the findings of the site characterisation and risk assessment and dependent on the size and type of storage structure (e.g. depleted hydrocarbon field, deep saline formation). The justification for not deploying specific techniques should be documented. The types of monitoring measurements that could be considered include:

- **Time Lapse Seismic, 4C Seismic** – for certain storage sites seismic data monitoring may be appropriate to detect the movement of injected CO<sub>2</sub> plume into the formation. This can either be a time-lapse seismic monitoring where 3D surveys are repeated at various intervals over time, or as a 4C seismic survey where Ocean Bottom Cables are permanently installed and able to record the shear (S) waves as well as the P waves. A baseline seismic survey will be required prior to commencing injection of

CO<sub>2</sub>. The value of deploying these techniques will be dependent on the depth and geology of the storage site and shall be reviewed on a case by case basis.

- **Gravity surveys** requires sea floor measurements and a baseline survey.
- **Micro-seismicity** – for certain storage sites it may be appropriate to drill an observation well with recording tools to detect micro-earthquakes in the vicinity of the well bore.
- **Regular pressure build-up testing** – to determine formation limits and connectivity
- **Multi-well testing using observation wells** – to characterise flow paths and geological connectivity. For example, a permanent pressure observation well completed just above the cap-rock could provide a very sensitive CO<sub>2</sub> leak detector
- **CO<sub>2</sub> Injection and Production Rates** – The quantities of CO<sub>2</sub> injected into the storage site need to be carefully monitored and explanations provided for any unexpected changes in well injectivity. In the case of EOR projects it is highly likely that CO<sub>2</sub> will appear at oil production wells at some stage in the project and this CO<sub>2</sub> production needs to be accounted for in calculating overall storage rates.
- **Tracer Testing** – to more precisely determine CO<sub>2</sub> flow pathways within the storage site.
- **Core Analysis** – Data from cores obtained from new injection wells can yield valuable information on the effects of injecting CO<sub>2</sub> into the formation. Core testing can also yield valuable information on parameters such as the rate of CO<sub>2</sub> trapped by dissolution by other formation fluids (e.g. water), which will help gauge confidence in the long term storage behaviour and risks.
- **Seabed Monitoring** – Monitoring of the seabed above the storage site to identify CO<sub>2</sub> leakage.

## 2.2 Long Term Monitoring Plan

The Post Closure Plan requires a discussion of the monitoring techniques that will be conducted after the operational phase of CO<sub>2</sub> injection has finished. The details of this long-term monitoring plan shall be discussed in a provisional Post Closure Plan, which shall be submitted [with the Storage Permit application] as a separate document for approval by DECC. The long-term monitoring plan will be site specific and may include use of dedicated pressure observation wells, ongoing seismic surveys etc. Whatever techniques are selected, they must be able to identify any leakages or significant irregularities. The plan should be updated as necessary, taking account of risk analysis, best practice and technological improvements.

The long term monitoring plan should also include the options for remedial action if test results are not as anticipated.

## 2.3 Surface facilities and equipment process monitoring

The plan should also describe the monitoring programme that will demonstrate the pipeline and associated facilities continue to operate within

the planned performance characteristics over the full life cycle. It should explain the monitoring methodology and justification for choice, sampling methodology (e.g. on-line, continuous or point sampling) and the monitoring frequency. As a minimum, the following parameters should be included in the plan:

- CO<sub>2</sub> volumetric flow at injection wellheads;
- CO<sub>2</sub> pressure and temperature at injection wellheads (to determine mass flow);
- injectivity and fall-off testing;
- chemical analysis and properties of the injected fluid (including temperature and solid content, the presence of incidental associated substances and the phase of the CO<sub>2</sub> stream);
- mechanical integrity of seals and (abandoned) wells;
- containment of the CO<sub>2</sub> stream; and
- control measures, overpressure, emergency shut down system.
- fugitive emissions of CO<sub>2</sub> at the injection facility
- pipeline wall thickness, corrosion coupons, valve seal performance

### **2.3 Updating the plan**

The data collected from the monitoring activities shall be collated and interpreted. The observed results shall be compared with the predicted behaviour in the dynamic simulation of the 3-D-pressure-volume. Where there is a significant deviation between the observed and the predicted behaviour, the 3-D-model shall be recalibrated to reflect the observed behaviour. The recalibration shall be based on the data observations from the monitoring plan, and where necessary to provide confidence in the recalibration assumptions, additional data shall be obtained. Data shall also be used to revise and update the risk assessment.

Where new CO<sub>2</sub> sources, pathways and flux rates or observed significant deviations from previous assessments are identified as a result of history matching and model recalibration, the monitoring plan shall be updated accordingly.

The yearly report to the competent authorities should encompass the above. If needed comment on site-specific monitoring problems.

APPENDIX 6

BP'S RESPONSE TO ORSTED'S RESPONSE TO QUESTION INF.1.2 OF THE EXA'S FIRST WRITTEN QUESTIONS

ExQ1	Question to:	Question
INF.1.2	Applicant	<p><b>Endurance Carbon Capture and Storage (CCS)</b></p> <p>Chapter 11 of the ES [APP—023] acknowledges that in the absence of mitigation that the Proposed Development has the potential to effect Endurance CCS and it indicates that discussions with the promoters of this scheme are “on-going”. Can you:</p> <ol style="list-style-type: none"> <li>i. Provide an update with regards to these discussions.</li> <li>ii. Indicate how the proposed mitigation referred to in the ES [APP-023, eg paras 11.11.3.10, 11.11.7.7 and 11.11.13.7] would be secured.</li> <li>iii. Advise how the conclusion that the impact on Endurance CCS would be negligible [APP023, paras 11.11.3.12, 11.11.7.9 and 11.11.13.13] was reached when the mitigation that might be required is currently unknown and, in any event, appears unsecured.</li> <li>iv. Explain what weight can be given to the conclusion that the impact on Endurance CCS would be negligible given that at this stage it would appear that the mitigation that might be required is unknown and, in any event, appears to be unsecured?</li> </ol>
	Orsted's response	<ol style="list-style-type: none"> <li>i. The Applicant has fortnightly meetings with bp, the operator of the Northern Endurance Partnership which include technical, commercial and consenting-related discussion. The Applicant and Northern Endurance Partnership are targeting a resolution of outstanding matters prior to the close of Examination however as identified in the Position Statements submitted by both parties at DL1 G1.29: Position Statement between Hornsea Project Four and bp (REP1-057) there are significant challenges to a commercial resolution. The Applicant therefore continues to advocate a set of protective provisions for the benefit of the licensee from time to time of the UK Carbon Dioxide Appraisal and Storage Licence CS001 in Part 8 of Schedule 9 of the draft DCO for Hornsea Four to allow both projects to continue development in the overlapping area of seabed ('the Overlap Zone')</li> <li>ii. The Applicant considers that, in a similar manner to commercial cable crossing agreements that are commonplace in the offshore wind industry, the mitigation set out in paragraphs 11.11.3.10, 11.11.7.7 and 11.11.13.10 of A2.11: Infrastructure and Other Users (APP-023) will be secured by a commercial agreement with the developers of the Endurance CCS site. It is important to note that the Applicant has proposed protective provisions for the benefit of the licensee from</li> </ol>

ExQ1	Question to:	Question
		<p>time to time of the UK Carbon Dioxide Appraisal and Storage Licence CS001 in Part 8 of Schedule 9 of the draft DCO for Hornsea Four, which envisage co-existence in the Overlap Zone. The Applicant considers that the proposed protective provisions address the known uncertainties and seek to put in place a process to ensure successful coexistence. See paragraphs 5.5 to 5.10 of G1.29 Appendix 1: Summary of the Applicant's position regarding the interface with the Northern Endurance Partnership Project (REP1 -057) for further justification for the Applicant's position that coexistence is possible and the mechanisms that could be employed to achieve this.</p> <p>iii. Additionally, the commercial relationship between the Applicant and bp is governed by an Interface Agreement (further detail on this agreement is provided in G1.29 : Position Statement between Hornsea Project Four and bp (REP1 -057 ) with both parties agreeing to establish an Interface Management Group comprising the project managers for the Applicant and the developers of the Endurance CCS site, establishing communication and liaison on planned activities (such as planned operations and maintenance and development activities) so as to be able to plan and reduce or avoid adverse effects. The Applicant considers that the combination of protective provisions (once agreed with bp), the Interface Management Group and commercial agreements offers comfort that the mitigation is secured resulting in the conclusion that the impact upon Endurance CCS would be negligible</p> <p>iv. As set out in paragraph 11.11.3.8 of A2 .11: Infrastructure and Other Users (APP -023), the Applicant acknowledges that the Endurance CCS site is considered to be of high value regionally and nationally, both in economic terms and contributing to government targets set out in the Energy White Paper (Powering our Net Zero Future), and is therefore considered to be of high sensitivity within the Overlap Zone. The Applicant also acknowledges that the magnitude of the impact of the construction, operation and decommissioning of Hornsea Four on the proposed CCS site and associated infrastructure has the potential to be, on a worst case and precautionary basis, moderate, but noting that there is currently a high level of uncertainty associated with the planned development activities associated with the Endurance CCS site within the Overlap Area. The Applicant considers that in the absence of any mitigation, the potential impact on the CCS development activities arising from the operation and maintenance of Hornsea Four, within the Overlap Zone, is considered to result in a potential significance of moderate or large (the extent of significance being dependent on the final details of the CCS scheme and the extent of the interaction with Hornsea Four, but in any event, considered, on a</p>

ExQ1	Question to:	Question
		<p>worst case and precautionary basis, to be potentially significant in EIA terms, noting again the high level of uncertainty relating to the proposed CCS development details).</p> <p>v. The Applicant considers that with the development of effective mitigation on the basis set out in the Application and secured in the manners set out in (ii) and (iii) above, the impact within the Overlap Zone will have a residual magnitude of negligible, which combined with a high sensitivity, results in a residual significance of slight, which is not considered significant in EIA terms.</p> <p>vi. The Applicant maintains that coexistence in the whole of the Overlap Zone is possible and the protective provisions have been designed to allow additional time for the NEP Project (and the novel carbon capture storage technology) to mature to resolve any outstanding bp concerns in this regard. The Applicant believes these provisions strike the appropriate balance to manage the interests between the parties and the requirement for coexistence prescribed in the Interface Agreement and relevant policy.</p> <p>vii. The Applicant considers that the assessment in relation to the potential impact of the construction, operation and decommissioning of Hornsea Four on the proposed CCS site and associated infrastructure presented in A2.11: Infrastructure and Other Users (APP -023) is appropriate and robust, noting that no planning application has been submitted in relation to the offshore elements of the Endurance CCS project. The Applicant acknowledges this high level of uncertainty associated with the planned development activities associated with the Endurance CCS site within the Overlap Zone and notes that this level of uncertainty has been built into the assessment on a precautionary basis. Relevant details from the offshore elements of the Northern Endurance Partnership project will be considered within assessment if made available during Examination. Notwithstanding this, the Applicant considers that the combination of protective provisions, the Interface Management Group and commercial agreements offers comfort that the mitigation is secured and therefore the residual significant would be not significant in EIA terms.</p> <p>viii. The Applicant and the wider Ørsted group of companies has considerable experience in developing coexistence with oil and gas operators/owners particularly relating to vessel and helicopter access to existing and proposed infrastructure. The mitigations therefore that apply to the access issues put forward by NEP are known and the Applicant is therefore confident of being able to resolve these issues to ensure coexistence in line with policy.</p>

ExQ1	Question to:	Question
	<p>bp's response to Orsted's response</p>	<p>bp provided its own response to this question at Annex 1 of its Deadline 2 submission (<a href="#">REP2-062</a>) and noted in particular its comments on Orsted's approach to their ES insofar as it relates to the NEP project were set out in section 16 of its Deadline 1 submission (<a href="#">REP1-057</a> – Appendix 2 (electronic page numbers 142 to 145), which highlighted the specific areas in which bp considers Orsted's assessment to be currently inadequate.</p> <p>bp has set out below its additional responses against the individual paragraphs to this question to address Orsted's further submissions detailed in its response above.</p> <ul style="list-style-type: none"> <li>i. bp responded in detail in the main body of its Deadline 2 submission regarding the current status of discussions with Orsted regarding the interface between the respective projects and advocated why its own proposed protective provisions should be preferred in lieu of Orsted's alternative set. As Orsted notes, regular meetings/engagement have continued between the parties to seek to agree an appropriate resolution; however, no agreement has been reached to date and it is bp's position that such agreement would simply reflect the practical effect of the protective provisions put forward by bp (see Annex 3 of its Deadline 2 submission) by ensuring the necessary geographical separation between the respective projects. This is then relevant to Orsted's approach to, and comments on, their assessment in the subsequent paragraphs to this response.</li> <li>ii. bp explained in section 7 of its Deadline 2 submission (<a href="#">REP2-062</a>) why Orsted's proposed protective provisions are inappropriate and in sections 5 and 6 of the same submission why co-existence is not, and will not, be possible between the projects within the Overlap Zone and so why bp's own protective provisions should be preferred to resolve the interface. By consequence, the mitigation approach referenced by Orsted in paragraphs 11.11.3.10, 11.11.7.7 and 11.11.13.10 of A2.11: Infrastructure and Other Users (APP-023) is flawed for the same reasons.</li> <li>iii and iv. bp has jointly responded to Orsted's response to paragraphs (iii) and (iv) of this question below.</li> </ul> <p>bp considers the ExA's query succinctly captures the essential flaw in Orsted's assessment, namely that there is no proper basis on which to conclude that the impact on Endurance would be negligible in circumstances where the mitigation relied upon by Orsted in their</p>



ExQ1	Question to:	Question
		<p>assessment is uncertain and, in any event, unsecured. No material weight can therefore be attached to such conclusions for the purposes of decision-making by consequence.</p> <p>bp refers to its submissions above as to why the unspecified mitigation relied on by Orsted is unlikely to be forthcoming, or effective.</p> <p>Further, the Interface Management Group referenced by Orsted is the means through which engagement has occurred to date and under which bp has established that unfortunately co-existence is not possible for the reasons articulated in sections 5 and 6 of bp's Deadline 2 submission (<a href="#">REP2-062</a> (electronic page numbers 6 to 11)) . Accordingly, neither this management group, nor the existence of the Interface Agreement (for the reasons articulated in Annex 2 of bp's Deadline 2 submission and elaborated upon in Appendix 3 of this Deadline 3 submission) provide any comfort that the mitigation relied upon by Orsted is 'secured' in the manner suggested in their response. Indeed, they are the forum through which it has been confirmed that such mitigation will not be possible. In those circumstances, the suggestion made in Orsted's assessment that the impact will be 'negligible' is simply not credible, let alone reliable for the purposes of decision-making and so no weight should be attached to it.</p> <p>Orsted appear to suggest in paragraph (iv) of their response that the absence of mitigation would lead to a 'moderate' impact on Endurance 'on a worst case and precautionary basis' (with a corresponding significance of 'moderate or large'). It is unclear on what basis a moderate impact could credibly be concluded in those circumstances. bp and Orsted are not agreed on the <u>approach to</u> mitigation, but they are aligned on the <u>need for</u> mitigation and it must surely be accepted that the failure to mitigate would lead to impacts beyond 'moderate' under any scenario.</p> <p>It is submitted that the impact of Hornsea Project Four on Endurance will either be (i) 'negligible' in circumstances where bp's proposed protective provisions are incorporated into the Hornsea Four DCO as this would ensure the appropriate mitigation by providing for the necessary physical separation between the projects and the disapplication of the interface agreement which otherwise threatens the viability of the NEP project (as set out in bp's Deadline 2 submissions discussed above); or, in any other circumstance, (ii) 'major adverse' as the NEP</p>

ExQ1	Question to:	Question
		project will be unable to be built out in the Hornsea Project Four area (as explained in section 7 of bp's Deadline 1 submission ( <a href="#">REP1-057</a> – Appendix 2 (electronic pages 128 to 130))).