Triton Knoll Offshore Wind Farm Limited

Triton Knoll Electrical System

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Appendix 35: Response to Submission by Mr Ward at Deadline 4

Date: 01 February 2016

Appendix 35 of the Applicant's Response to Deadline 5

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Triton Knoll Electrical System

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Date: 01 February 2016

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Date of Approval:	01 February 2016
Revision:	1.0

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TABLE OF CONTENTS

1. MR WARD 4

1. MR WARD

1.1 Mr Ward submitted a Written Representation for Deadline 4 (5^{th} January 2016). The issues raised in the representation relate to the following:

- Option of HVAC or HVDC technology;
- Extent of agricultural land affected;
- Cable depth under private dyke; and
- Impacts on the nature of peaty soils.

Option of HVAC or HVDC technology

Economic and Efficient Investment

1.2 As a part of the development of the TKES design, the Applicant has an obligation to develop an economic and efficient solution for the electrical infrastructure; section 9 of the Electricity Act 1989 requires it: *"(a) to develop and maintain an efficient, co-ordinated and economical system of electricity transmission"*. High voltage direct current (HVDC) technology is significantly more expensive that high voltage alternating current (HVAC) and is used primarily for bulk transfer of power over very long distances. In these cases, the additional cost and losses associated with HVDC are accepted as there is no alternative connection solution.

1.3 The choice between HVAC and HVDC for a project is dependent on multiple factors, which include the length of transmission route and the amount of power that needs to be transmitted. In the case of Triton Knoll, the combination of a relatively low MW capacity compared to typical HVDC capacities and the relatively short length of the offshore cable route makes HVAC viable. The additional cost of what would be a sub-optimal HVDC connection cannot therefore be justified as an economic and efficient investment.

Technology Risk

1.4 Paragraph 2.2.3(a) of the Interface Selection Assessment Report (document reference 8.18) [APP-120] states that there are significant technology risks associated with HVDC due to the relatively limited track record of the technology, particularly in generation connection scenarios. Whilst some HVDC connections have been built in

Germany to serve multiple wind farm projects with a combined capacity significantly above 1 GW (1,000MW), to date no offshore wind project in the UK has yet used HVDC. GW scale projects which have a larger capacity and are further offshore than Triton Knoll (such as Creyke Beck and Teesside A & B projects within the Dogger Bank development zone) have selected HVDC as a connection technology as HVAC isn't feasible for connections of that length and capacity. Each of these projects are of a scale >1GW and range from 130-165km offshore, each requiring its own HVDC link. These projects are of a fundamentally different scale compared to Triton Knoll, which is a sub-GW project with a significantly shorter overall cable route.

1.5 Additionally, these projects are on a significantly later delivery schedule than Triton Knoll, with construction programmes moving into the late 2020s, which reflects the relative technology maturity and economic viability of this solution, even at these multi GW-scale projects. Triton Knoll is a sub-GW project which is relatively close to shore (circa 60 km) which lends itself to an HVAC solution. This will allow the project to be constructed and operational in a relatively short time period using proven, reliable and cost effective technologies.

Delivery of the Project

1.6 There is currently no prospect of a viable and cost effective HVDC technology solution for Triton Knoll becoming available in the delivery window for the project. The Hornsea One and Two projects referenced by Mr Ward both retain the option of using an HVAC solution to cover this technology risk. This view is further supported by the East Anglia One project which, having previously been awarded a DCO with an exclusively HVDC solution, has subsequently sought a DCO amendment to move from an HVDC to an HVAC connection (with a corresponding reduction in capacity from 1200MW to 750MW).

1.7 If there was prospect of a viable HVDC connection solution being available for the Triton Knoll project, it would be necessary to assume that two offshore converter stations would be required, to ensure all of the wind turbine generator (WTG) locations in the wind farm array can be connected into the HVDC system, and to ensure the deliverability of the project. This would result in up to four HVDC circuits to run from the offshore converter station to the onshore converter station, which is consistent with what has been proposed by the Hornsea One and Two projects referenced by Mr Ward.

1.8 This constraint on the HVDC system design would mean that there would not be the opportunity to significantly reduce the construction duration, or required corridor width, compared to HVAC technology. However, as set out in Section 4.9 of ***Addendum A: Further detail regarding the TKES cable corridor***, submitted as Appendix 29 of the

Applicant's response to Deadline 4, a four circuit solution is feasible in an HVAC system design, if 220kV is found to be a viable technical solution.

1.9 Additionally, even if HVDC was taken forward as a potential connection option, an HVAC solution would need to be retained within the Application to ensure the deliverability of the project. This would require the project to retain the ability to install up to six HVAC circuits to ensure a proven technical solution using 132kV as the transmission voltage was available. This would mean no reduction in the maximum construction or operational corridor would result.

Link Boxes

1.10 In relation to the question of whether link boxes would be required if HVDC was adopted as a transmission technology; it should be noted that the fibre optic cabling would still need to be installed as part of an HVDC system to provide communication links between the onshore and offshore converter stations. Link boxes would therefore still be needed along the cable route to accommodate the fibre optic joints and, potentially, signal boosting equipment.

Footprint of DC Converter Stations

1.11 The footprint of converter stations for HVDC technology solutions are usually larger than that of standard HVAC substations due to the need to accommodate the equipment that converts the HVDC power into HVAC. While the amount of outdoor equipment may reduce slightly in an HVDC compound, there would be the need for additional buildings to accommodate the converter equipment that would exceed the building dimensions that have been assessed and form part of the TKES Application.

1.12 In terms of the footprint required for the TKES onshore substation, the project has made a realistic worst case assumption of the footprint required to accommodate the necessary substation equipment and landscaping to ensure the project is deliverable and all impacts have been adequately assessed.

Extent of agricultural land affected

1.13 Table 1 sets out the Agricultural Land Classifications for the East Midlands Region, as stated as part of the Existing Environment identified in Volume 3, Chapter 5, *Land use, Soils and Agriculture* of the ES (document reference 6.2.3.5) [APP-046].

Agricultural Land Classification	Total ha per ALC grade (ha)	Total ha of ALC Grade 1,2 & 3 (ha)	Total ha of ALC Grade Grade 4 & 5 (ha)	Total ALC land (ha)
ALC Grade 1	76,728.90			
ALC Grade 2	288,333.25	1,251,313.67		
ALC Grade 3	886,251.52			1,450,895.03
ALC Grade 4	154,839.82		199,581.36	
ALC Grade 5	44,741.54			

Table 1: Agricultural Land Classifications for the East Midlands Region

1.14 The assessment considers "*Impacts on ALC land through soil disturbance*"; paragraph 5.70 of Volume 3, Chapter 5 states:

"The area within the Proposed Development Boundary (approx 441.9 ha) as a percentage of the total area of agricultural land with the East Midland Region is 0.0003%. As a percentage of Grade 1, 2 and 3 land within the East Midland Region, those areas within the Proposed Development Boundary represent 0.00035%."

1.15 Following a detailed review of the figures the Applicant acknowledges that an error has been made in the calculations and that the figures quoted should be as follows:

- 0.03% - the area within the Proposed Development Boundary as a percentage of the total area of agricultural land within the East Midland Region; and
- 0.035% - the area within the Proposed Development Boundary as a percentage of Grade 1, 2 and 3 land within the East Midland Region.

1.16 Table 2 provides a detailed breakdown of the revised calculations.

Total Proposed Development Boundary	441.9 ha
Total ALC land in East Anglia Region	1,450,895.03 ha
Proposed Development Boundary land take as a percentage of the total area of agricultural land with the East Midland Region	441.9 ha ÷ 1,450,895.03 ha x 100 = **0.03%**

Total ALC Grade 1,2 & 3 in East Anglia Region	1,251,313.67 ha
Proposed Development Boundary land take as a percentage of Grade 1, 2 and 3 total area of agricultural land within the East Midland Region	441.9 ha ÷ 1,251,313.67 ha x 100 = **0.035%**

Table 2: Calculations of area of agricultural land take within the Proposed Development Boundary during construction

1.17 Given that the corrected percentage figures remain very low, the impact to ALC land associated with soil disturbance would remain of ***low magnitude.*** The effects anticipated in the assessment of impact to ALC land during the construction phase remain of ***minor significance*** in EIA terms.

1.18 The assessment has also considered impacts on ALC land during the operational phase of the project; the Applicant acknowledges that the figures quoted in paragraphs 5.82 to 5.84 of Volume 3, Chapter 5 are also incorrect.

"Operation of the Intermediate Electrical Compound will result in the permanent loss of approximately 6.2 ha of Grade 3 ALC agricultural land. Operation of the Substation (including permanent access road) will result in the permanent loss of approximately 25.02 ha of Grade 2 ALC land and approximately 4.59 ha of Grade 1 ALC land. Operation of the landfall will result in the permanent loss of approximately 0.5 ha of Grade 3 ALC agricultural land.

The combined permanent agricultural landtake of 36.3 ha of land within the footprint of the Intermediate Electrical Compound and Substation including the Substation permanent access track, and landtake associated with the permanent access track and transition joint bays at the landfall, as a percentage of Grade 1, 2 and 3 land within the East Midland Region is 0.00003%."

1.19 Following a detailed review of the figures the Applicant confirms that the figures quoted should be:

- 0.003% - the area of combined permanent agricultural land take within the footprint of the Intermediate Electrical Compound and Substation including the Substation permanent access track, and land take associated with the permanent access track and transition joint bays at the landfall, as a percentage of Grade 1, 2 and 3 land within the East Midland Region.

1.20 Table 3 provides a detailed breakdown of the revised calculation.

Permanent landtake at IEC (Grade 3)	6.2 ha	Combined total land take: 36.31 ha
Permanent landtake at substation including access road (Grade 1 and Grade 2)	4.59 ha + 25.02 ha = 29.61 ha	
Permanent landtake at landfall (Grade 3)	0.5 ha	
Proposed combined permanent landtake, as a percentage of Grade 1, 2 & 3 land within the East Midland Region	36.31 ha ÷ 1,251,313.67 ha x 100 = **0.003%**	
Proposed combined permanent landtake, as a percentage of the total area of agricultural land with the East Midland Region	36.31 ha ÷ 1,450,895.03ha x 100 = 0.0025%	

Table 3: Calculations of area of agricultural land take within the Proposed Development Boundary during operation

1.21 Given that these corrected percentage figures remain very low, the impact to ALC land associated with permanent land take would remain of ***low magnitude.*** The effects anticipated in the assessment of impact to ALC land during the operational phase remain of ***minor significance*** in EIA terms.

Cable depth under private dyke

1.22 The Applicant notes Mr Ward's response to EOn 2.8 of the ExA's second written questions; as stated in the Applicant's own response to the question, the Applicant is committed to crossing all IDB and EA maintained watercourses at a minimum depth of 2 m plus safe working depth, which has been confirmed to be 0.9m. This commitment is secured through paragraph 5.8 – 5.9 of the Outline Construction Method Statement (CMS) (document reference 8.7.1) and Requirement 14(1)(a) of the draft DCO.

1.23 This depth was agreed for all of the IDB and EA maintained watercourses as these form the network of larger drains within the catchment and, for the purposes of reducing the risk of hydrology and flood risk impacts, it was agreed with the EA and IDBs early in the development of the project that crossing those watercourses using trenchless techniques, at a depth of 2.9m, was a preferable approach.

1.24 The assessment of impacts presented in Volume 3, Chapter 7 *Hydrology and Flood Risk* of the ES (document reference 6.2.3.7) has been undertaken on the basis of crossing IDB and EA maintained watercourses using trenchless techniques; and crossing all other watercourses using either open cut or trenchless techniques. As heard during the Local Impacts Issue Specific hearing held on 19th January 2016, open cut techniques are likely to be the preferred installation method for some ordinary watercourses. The Applicant will assess each watercourse on a case by case basis in order to determine a) the appropriate depth at which it should be crossed, based on several factors including depth of the watercourse; ground conditions; other engineering constraints within the vicinity of the watercourse, and b) the appropriate construction techniques for crossing at the depth identified.

1.25 All other ordinary watercourses (i.e. private dykes) were identified to be crossed at a minimum depth of 1 m plus safe working depth (0.9 m) using either open cut trenching or trenchless techniques. The IDBs have, however, requested that these are also crossed at a minimum of 2 m, plus 0.9 m safe working depth. The Applicant and the IDBs continue to discuss the matter of other ordinary watercourse crossing depths as summarised in Appendix 34 of the Applicant's response to Deadline 5, however it has been agreed that the Outline CMS should be updated in order to secure that watercourse crossing depths are at a minimum of 2.9m unless otherwise agreed with the relevant internal drainage board that a shallower clearance, up to a minimum of 1.9 m is appropriate.

1.26 It may therefore be that Mr Ward's dyke is afforded the same crossing depth and construction techniques as the IDB maintained watercourses, should it be determined to be appropriate; alternatively the dyke will be crossed with less cover than an IDB maintained watercourse however this will be no less than 1.9m, and will in not inhibit ordinary agricultural practices. The detail of all crossing depths will be determined post consent through detailed design phase, following pre-construction survey work.

Impacts on the nature of peaty soils

1.27 The Applicant notes Mr Ward's response to SE 2.9 of the ExA's second written questions; this matter was also raised during the Local Impacts Issue Specific hearing held on 19th January 2016 by Mr Ward and the Land Interest Group (LIG).

1.28 The Applicant confirmed that the exact nature of the soils would be surveyed and recorded in the pre-entry record of condition on a field by field basis and that this information would be taken into account during the detailed design stage. The detail of the surveys to be undertaken as part of the pre-construction work is set out in the Outline Soil Management Plan (SMP) submitted as Appendix 14 of the Applicant's response to Deadline 5.

1.29 The Applicant notes the comments made by Mr Ward with regards to the specific nature of peat soils; it was heard at the Local Impact Issue Specific hearing held on 19th January 2016 that Mr Ward was concerned by the shrinkage and oxidation of peat soils. The Applicant has provided clarity on this matter in the *Agricultural Land Clarification Note* submitted as Appendix 19 of the Applicant's response to Deadline 5.

1.30 The Applicant notes that the use of peatlands for improved pasture, for arable or for horticultural production requires drainage. Drainage leads to subsidence of the ground surface and the eventual destruction of the fragile peat. There are several components to peat wastage, the general term used to account for the loss of peat:

- Shrinkage – the removal of large amounts of water from the peat produces rapid initial shrinkage, with rates of 18 cm/a in Holme Fen, Cambridgeshire, between 1850 and 1860 (Hutchinson, 1980);
- Compression – drainage also reduces the buoyancy effect of water which causes compression of peat under its own weight and increased bulk density. Passage of machinery increases the compaction;
- Oxidation – under the ensuing aerobic conditions, decomposition (biochemical oxidation) becomes the dominant processes, mainly affecting the peat above the watertable
- Other lesser components of wastage, including:
    - Wind erosion – where spring-sown crops offer a bare, loose soil surface to strong winds
    - Removal of soil on root crops
    - Accidental burning of dry peat

1.31 Rates of peat wastage have been assessed in the report commissioned by Cranfield University for the RSPB titled "An estimate of peat reserves and loss in the East Anglian Fens[1] (Holman, 2009).

1.32 This report (at Figure 3, Holman, 2009) identifies that the TKES cable corridor passes in proximity to an area of peat remnant. These are areas which were likely to have originally been peat soils but which have wasted to humose or mineral soils, termed skirtland. Very localised areas of thin peat may be present within these areas.

1.33 Wastage rates are anticipated to be 0.7-2.1 cm/yr for areas of peat (not Remnant Peat) under intensive cultivation. The potential for wastage of Remnant Peat is very much reduced because wastage has already occurred resulting in its current condition. However, the Applicant considers that this is a reasonable worst case rate of wastage

[1] https://www.rspb.org.uk/Images/Fenlandpeatassessment_tcm9-236041.pdf

that can inform the detailed design stage to ensure cables are installed at a sufficient depth to accommodate any future peat wastage appropriately.