East Anglia Offshore Wind

VATTENFALL

SCOTTISHPOWER RENEWABLES

## East Anglia THREE

# Cable Statement

Document Reference – 7.1

Author – East Anglia THREE Limited
East Anglia THREE Limited
Date – November 2015
Revision History – Revision A

East Anglia THREE Limited

East Anglia THREE Offshore Windfarm

Cable Statement

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| Document Reference | 7.1 |
| APFP Regulation | 6(1)(b)(i) |
| Author | East Anglia THREE Limited |
| Date | 18 November 2015 |
| Revision | Version 1 |

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## 1 Summary

1.1 East Anglia THREE Limited (**EATL**) is planning to develop the East Anglia THREE Offshore Windfarm (the **Project**) with up to 172 turbines and with an installed capacity of up to 1,200 MW. The Project would be located approximately 69km from the coast at Lowestoft, covering an area of approximately 305km2.

1.2 As the total installed electricity generating capacity will exceed 100 MW, the Project is deemed to be a Nationally Significant Infrastructure Project (**NSIP**), and therefore EATL is submitting an application to the Secretary of State under Section 37 of the Planning Act 2008 for a Development Consent Order (**DCO**) for the construction and operation of the Project.

1.3 EATL is currently considering constructing the Project in either a Single Phase or under a Two Phased approach. Under the Single Phase approach the Project would be constructed in one single build period and under a Two Phased approach the Project would be constructed in two phases each consisting of up to 600MW, installed consecutively.

1.4 The DCO application also seeks flexibility to construct the Project with either a High Voltage Direct Current (HVDC) or a Low Frequency Alternating Current (LFAC) electrical solution. A decision on the final electrical solution for the Project would be made following consent, during the final design stage of the Project.

1.5 This Cable Statement has been prepared in accordance with Regulation 6(1)(b)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (the **APFP Regulations**) which requires the applicant for a DCO for the construction of an offshore generating station to provide a statement regarding the route and method of installation of any cable connecting the generating station to the onshore electricity transmission network.

1.6 EATL's application contains all of the electrical grid connection works required for the Project, summarised as follows:

1.6.1 The offshore electrical components for the Project consist of inter-array, inter-substation and up to four export cables that take the power from the wind turbine generators (**WTG**) to shore. The offshore electrical assets also consist of up to six offshore electrical stations (comprising up to four offshore collector substations and up to two offshore converter substations), up to two fibre optic cables, up to one accommodation platform, up to two meteorological masts and up to 12 buoys.

1.6.2 The offshore works would also include the interconnection between the Project and the East Anglia ONE Offshore Windfarm, the latter having been constructed pursuant to the East Anglia ONE Offshore Wind Farm Order 2014 (the **East Anglia ONE Order**).

1.6.3 The onshore electrical works consist of up to four HVDC cables or up to 12 LFAC cables (three bundled together in a trefoil or laid flat within each duct) and up to two fibre optic cables (bundled with the onshore export cables) pulled through ducting which has been pre-laid pursuant to the East Anglia ONE Order, running from transition pits at the landfall at Bawdsey to a new onshore substation in the vicinity of the National Grid substation at Bramford and an underground connection between the two substations. At the substation location trenching will be required to lay cables directly underground where no pre-laid ducts have been installed.

1.7 The Grid Connection Agreement that has been secured by EATL is for a connection located at Bramford in Suffolk.

## 2 Introduction

2.1 This Cable Statement has been prepared by East Anglia THREE Limited (**EATL**) pursuant to Regulation 6(1)(b)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 (the **APFP Regulations**).

2.2 This Statement forms part of the application to the Secretary of State for the Project for a Development Consent Order (**DCO**) to construct and operate an offshore generating station with up to 172 turbines and a maximum installed capacity of up to 1,200 MW. As the total installed capacity of the Project will exceed 100 MW it is a Nationally Significant Infrastructure Project (**NSIP**) as defined under sections 14(1)(a) and 15(3) of the Planning Act 2008.

2.3 The offshore array is located in the East Anglia Zone in the North Sea, which is being developed as a number of individual windfarms, each of which will require the appropriate statutory consents and approvals. East Anglia ONE Offshore Windfarm was the first to be proposed within the East Anglia Zone and a decision was made by the Secretary of State to grant the DCO for that project on 17 June 2014.

2.4 The Project comprises the next stage of development in the East Anglia Zone. The Project would be located approximately 69km from the coast at Lowestoft, covering an area of approximately 305km$^2$.

2.5 Further information on the location and design of the Project is set out in the accompanying Environmental Statement (Volume 1, Chapter 5) (Document 6.1).

2.6 This Statement provides details of the proposed offshore and onshore cable routes and cable installation methods and is intended to provide a summary of the detailed information set out in the Project Description of the Environmental Statement.

## 3 Description of Grid Connection Works

3.1 EATL's application for a DCO (the **Application**) contains all of the electrical cable works required for the Project.

<u>Electrical solution</u>

3.2 EATL is considering both a High Voltage Direct Current (**HVDC**) and a Low Frequency Alternating Current (**LFAC**) electrical solution for the Project. The key differences between the HVDC and LFAC solution are as follows:

3.2.1 The LFAC solution does not require offshore converter stations, whereas the HVDC solution requires up to two converter stations to convert the AC current produced by the turbines to HVDC for export to shore.

3.2.2 The LFAC solution may require a greater amount of electrical cable to be installed onshore, with up to 12 individual cables within ducts compared to four cables with the HVDC solution.

3.2.3 The LFAC solution will require a slightly larger compound area for the onshore substation.

3.3 A decision on the final electrical solution for the Project will be made post-consent during the final design stage of the Project. The ES considers the worst case parameters, whether they be from the HVDC or LFAC solution, which are then reflected in the DCO.

3.4 In the event that a Single Phase approach is adopted, the offshore and onshore cable will be installed as part of the single phase. If a Two Phase approach is adopted, a separate cable installation will be undertaken as part of each phase.

<u>Offshore works – from array to mean high water springs</u>

3.5 Inter-array cables will collect and transfer power generated by the WTG to the offshore collector substations. The cables connect the WTGs together into strings, with the number of WTGs connected together depending on factors such as the generation capacity of each WTG on the relevant cable network, distance between wind turbines and the cable sizes available. The strings of WTGs would then in turn be connected to the offshore collector substations.

3.6 Under the HVDC solution, up to four offshore collector substations and two offshore converter substations would collect electricity from the wind turbines and transport it to shore via up to four export cables. Under the LFAC solution, up to four HVAC offshore collector stations would collect electricity for transportation to shore via up to four export cables.

3.7 The offshore works also include the interconnection (being up to four cables) between the Project and the East Anglia ONE Offshore Windfarm. This would comprise platform link cables between platforms in East Anglia THREE and platforms in East Anglia ONE.

3.8 The export cables would connect the offshore development to a landfall at Bawdsey on the Suffolk coast. The offshore cable corridor is approximately 166km in length from the edge of the Project site to the landfall location.

<u>Onshore connection works – from mean low water to grid</u>

3.9 The onshore cable ducts for two future projects are included in the East Anglia ONE Order as associated development. The East Anglia ONE Order requires (subject to limited exceptions) the onshore cable ducts for the two projects to be laid at the same time as the laying of the onshore cables for East Anglia ONE.

3.10 East Anglia THREE has adopted the same landfall point as East Anglia ONE, and as for East Anglia ONE will also connect to the National Grid onshore transmission network at Bramford in Suffolk. Accordingly, East Anglia THREE will follow the same connection route and cable corridor as East Anglia ONE.

3.11 Therefore, the application for East Anglia THREE includes any further works to pull the onshore cables through any (previously laid) onshore ducts. It also includes works to directly lay cables underground in the vicinity of the substation (where there are no pre-laid ducts).

3.12 The onshore transition bays, where the offshore cables join the onshore cables, would be located at Bawdsey Cliffs. Up to four onshore transition bays located adjacent to each other will be required whether the Project is constructed using a Single Phased or Two Phased approach.

3.13 The onshore cable route would run between the onshore transition bays and the new onshore substation at Bramford in Suffolk. The route is approximately 37km long in a predominantly northerly, then westerly direction from Bawdsey, passing through mainly agricultural land. .

<u>Onshore substation</u>

3.14 Under both the HVDC and LFAC solutions the worst case for the Project is for two adjacent onshore substations in the same compound, either as a Single Phase or to provide for a potential Two Phased approach to construction of the wind farm (see section 6 of this Statement).

3.15 The proposed site for the onshore substation(s) is adjacent to the north of the existing National Grid Electricity Transmission plc (NGET) Bramford substation and east of the East Anglia ONE converter station. “Onshore substation" is defined as a compound containing electrical equipment including power transformers, switchgear, electrical protection equipment devices (disconnectors, circuit breakers), reactive compensation equipment, harmonic filters, cables, lightning protection masts, control buildings, communications masts, back-up generators, access, fencing and other associated equipment, structures or buildings and, depending on the type of substation, specific equipment such as one or more converter halls, and/or medium or high voltage switchgears.

3.16 The purpose of the onshore substation(s) is to change the electrical current from HVDC to HVAC, or in the case of the LFAC system to be compatible with the National Grid in the electrical transmission network.

3.17 The onshore HVDC converter station(s) or LFAC substation(s) would be located within a single compound that would not exceed 3.04ha. The total number of buildings housing the principal electrical equipment within the compound would not exceed two and their total footprint would not exceed 116 metres in length and 85 metres in width. Heights of buildings within the compound would not exceed 25 metres above existing ground level, and outdoor electrical equipment would not exceed a height of 15 metres above existing ground level. The worst case parameters have been assessed and included in the draft DCO.

3.18 In the HVDC electrical solution, in addition to the main converter halls, the compound would contain electrical equipment including power transformers, switchgear, reactive compensation equipment, harmonic filters, cables, lightning protection masts, control buildings, communications masts, backup generators, access, fencing and other associated equipment, structures or buildings. The onshore substation(s) would have a compact layout, with the majority of equipment contained in typical agricultural style buildings.

3.19 The onshore substation(s) would be connected to the existing National Grid substation at Bramford by means of underground cables laid directly into the ground, or installed into pre-laid ducts where pre-laid ducts have already been installed.

## 4 Consenting of Grid Connection

4.1 Part 1 of Schedule 1 of the draft DCO describes the works for which development consent is being sought.

Offshore works – from array to mean high water springs

4.2 The inter-array cables, up to one accommodation platform, up to two meteorological masts and up to 12 buoys form part of the Generating Station NSIP set out within Work No 1.

4.3 Up to six offshore electrical stations comprise Work No. 2 and the cable connections between the offshore stations and the export cables seaward of mean low water comprise Work Nos. 3 and 5A. Works numbered 2, 3 and 5A are considered to be "associated development" to the Generating Station NSIP within Section 115 of the Planning Act 2008, in that they are not an aim in themselves but are required to export the electricity generated by the turbines.

4.4 The interconnection between East Anglia ONE and East Anglia THREE (Work No. 4) is also included as associated development. The interconnection is required for the transmission of electricity between either windfarm.

Onshore connection works – from mean low water to new onshore substation

4.5 EATL has included its onshore works from mean low water to the new onshore substation as "associated development" within its DCO application to the Secretary of State. The export cables from mean low water to the transition pits at Bawdsey comprise Work No. 5B, the transition pits comprise Work No. 7, the underground cables running from the transition bays to EATL's new onshore substations and associated accesses, lay down areas and landscaping comprise Work Nos. 5B to 65 and 68 to 69, and the new onshore substations and connection to Bramford substation comprise Work Nos. 67 and 66 respectively.

## 5 Description of generating equipment

5.1 The WTG consists of three primary components, i.e. the tower, the nacelle and the rotor. The rotor is the device which, through circular motion, extracts the energy from the wind. The nacelle houses the equipment that can turn rotational motion into electrical energy. The tower supports the nacelle and gives the rotor the necessary height.

5.2 The capacity of the Project will depend on the number of WTGs that are installed and their individual rating. The Project would consist of up to a maximum of 172 WTGs, with combined output not exceeding 1,200 MW, and a rotor diameter range of up to 220 metres.

5.3 In the UK, offshore windfarm developers such as EATL can either construct the offshore transmission assets themselves or opt for an Offshore Transmission Owner (OFTO) to do so. Offshore transmission assets generally consist of the onshore infrastructure required to connect to the national electricity transmission system, the offshore export cables and offshore electrical stations. If EATL constructs the assets itself, then it must transfer the assets to an OFTO post-construction and pre-operation. OFTOs are selected on a competitive basis through a tender process. It is anticipated that EATL will opt for the generator build option which means that the offshore transmission assets will be transferred to an OFTO post construction and pre-operation. If construction is carried out in two phases then it is possible that each phase could be transferred to separate OFTOs.

## 6 Offshore cable installation

Phasing of construction

6.1 EATL is considering constructing the Project in either a Single Phase or in a Two Phased approach. Under a Single Phase approach the Project would be constructed in one single build period and under a Two Phased approach the Project would be constructed in two phases each consisting of up to 600MW. This is more fully set out in Chapter 5 of the Environmental Statement (Document 6.1).

Cable installation methods

*Inter-array cables*

6.2 The inter-array cables will be buried, where it is feasible to do so. Optimum burial depth may not be achieved in areas of rock outcrop or where there is a high frequency of boulders. Where optimum burial depth is not achieved the cable may be protected to prevent movement of the cables, to prevent any risk to other marine users and to protect the cables from impacts arising from other marine activities such as fishing.

6.3 The inter-array cables are expected to be installed from a cable laying vessel, which will be equipped with specialist cable handling equipment and will have support vessels in attendance as necessary, for example anchor handling. The cables are loaded on to cable carousels or cable drums, mounted on the deck of the vessel.

6.4 There are several different methods available for the installation of offshore cables, including the following:

- Ploughing

  The cable is simultaneously laid and buried. The cable plough lifts a section of the seabed deposit and places the cable below. The seabed deposit is then returned to its original position. In areas of very hard substrate modifications to this technique may be used, including use of a rock cutter plough or vibrating share plough.

- Trenching

  This method consists of three operations. First, a trench is excavated or cut while placing the sediment and fill next to the trench. The cable is subsequently laid in the trench and lastly the sediment or fill is returned to the trench. Pre-lay cutting of trenches (or "pre-trenching") could also be used whereby a large trench is cut in one or multiple passes to the correct depth before the cable is laid back in trench at a later date. The trench can be backfilled naturally or if required with a backfill plough or other method of material replacement. The use of backfill ploughs is normally not favoured due to the danger of damaging the cable.

- <u>Jetting</u>

  The cable is first laid on the seafloor. An ROV equipped with high pressure water jets then proceeds along the cable route, fluidising the seabed around the cable, allowing the cable to be lowered into the trench. The fluidised sediment subsequently settles back onto the seabed.

- <u>Vertical injector</u>

  In shallow waters a vertical injector could be used. This is a large jetting and cutting shear which is strapped to the side of a barge and the cable is laid in the foot of the trench. The burial depth is controlled by means of raising or lowering the tool and horizontal positioning, by means of adjusting the barge anchor.

6.5 The extent to which these cable burial techniques will be used will be dependent upon the results of detailed pre-construction seabed surveys of the final cable route and the associated cable burial assessment process.

*Export cables and interconnection*

6.6 The same techniques described for array cable installation will be used to install the export cables between the offshore electrical stations to the point offshore where the landfall ducts exit the seabed and also the interconnector cables between East Anglia ONE and East Anglia THREE.

6.7 Export cables between the offshore electrical stations and landfall may require a number of connections or joints along their length. Jointing of the offshore export cable will be undertaken at sea. Each jointing connection will require approximately ten days for completion. Additional time will also be required to recover both ends of the cable to the vessel for jointing and to re-bury the cable following jointing. Due to the complexity of offshore jointing, the number of joints will be kept to a minimum.

*Cable protection*

6.8 In some cases the above installation techniques cannot be applied and it is necessary to use alternative methods for installing the cable when it cannot be buried. Details of some of the techniques employed are given below:

- <u>Concrete mattresses</u>

  These are prefabricated flexible concrete coverings that are laid on top of the cable. Grout or sand filled bags could be used as an alternative to concrete mattresses for smaller scale activities.

- <u>Rock Placement</u>

  Rock placement involves the laying of a rock layer on top of the unburied cable to offer protection from and to fishing gear and vessel anchors.

- Frond mattresses

  Frond mattresses could be used to provide protection by stimulating the settlement of sediment over the cable. This method develops a sandbank over time protecting the cable but is only suitable in certain water conditions. This method may be used in close proximity to offshore structures although experience has shown that storms can strip deposited materials from the frond.

- Uraduct

  Uraduct is effectively a protective shell which comes in two halves and is fixed around the cable to provide mechanical protection. Uraduct is generally used for short spans at crossings or near offshore structures where there is a high risk from falling objects or abrasion. Uraduct does not provide protection from damage due to fishing trawls or anchor drags.

6.9 Where cable crossings occur they will be protected using the concrete mattress or rock placement methods for cable protection described above.

Cable landfall and directional drilling works

6.10 As a result of engineering constraints and to avoid direct impact on the Red Crags SSSI, the East Anglia ONE Order provides that the landfall construction will be undertaken using the Horizontal Directional Drilling (**HDD**) method. Therefore the works for East Anglia THREE at the landfall would be reduced to cable pulling, construction of a ramp over the cliff in the event of the short HDD pull through method being utilised, and construction of transition bays at the landfall.

## 7 Onshore cable installation

Transition bays

7.1 Each transition bay would comprise a buried concrete-lined structure. The purpose of the transition bay at the landfall would be to contain the joint between the offshore cables and the onshore cables. Access to the cables for maintenance would be via one of two options; either a manhole or other suitable access cover, or alternatively via kiosks. Kiosks would comprise a box measuring 1m x 0.75m by 1m high. There would be one kiosk per joint per cable therefore a maximum of four kiosks at the transition bays. These would be installed once the transition bays had been constructed. For either a single or Two Phase approach, four separate transition bays would be required.

Onshore cabling

7.2 The installation of up to eight ducts for cables for two future projects will already have been undertaken pursuant to the East Anglia ONE Order. Therefore, the cables for East Anglia THREE will need to be pulled through up to four of the pre-installed ducts.

7.3 The onshore cabling between the transition bays and the new onshore substation would be approximately 37km in length. As the onshore cabling typically comes on drums of up to 1,000m in length, further jointing bays will be required along the onshore cable route to join each section of the cable together.

7.4 Jointing bay locations for East Anglia THREE may not correspond to the locations specified for East Anglia ONE as different cable technology or an alternative supplier could be used. When the jointing bay locations have been determined each would be excavated, the pre-installed ducts would be exposed and a lightly reinforced concrete slab would be cast for the base of the jointing bay.

7.5 The cable drum would be delivered to each of the jointing bays and a cable pulling system would be installed into the trench. Once on site, the cable drum would be raised off the ground on hydraulic jacks to enable it to spin freely when pulled. The cable would then be pulled from the drum into the trench using the pre-installed rollers, with sufficient cable pulled through to the far jointing pit to allow for jointing onto the next section. The process would be repeated for the second cable to be installed in the duct.

7.6 Under a Single Phase approach jointing bays (each containing two sets of cables) would be completed simultaneously; once constructed each jointing bay would consist of a concrete box which would house two jointed cables. Under a Two Phased approach jointing bays (each containing two sets of cables) would be constructed in each phase. For a Two Phased approach, there would be two cable pull through operations and jointing bays may be sited in different locations along the cable route (depending on the contractor's construction proposals).

## 8 Onshore substation construction

8.1 An onshore substation will be required to convert the electricity to 400 kV for connection to the National Grid transmission network. Construction will include a number of key stages, including earthworks, foundations, superstructure and equipment installation.

## 9 Status of grid connection

9.1 East Anglia Offshore Wind Limited, EATL's parent company, secured a Grid Connection Agreement from National Grid for a connection located at Bramford in 2010.

**Document 7.1 Ends Here**