East Anglia ONE North Offshore Windfarm

Chapter 6

Project Description

Preliminary Environmental Information
Volume 1
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Glossary of Acronyms

AC	Alternating Current
AONB	Area of Outstanding Natural Beauty
CAA	Civil Aviation Authority
CBS	Cement Bound Sand
CCS	Construction Consolidation Sites
CPT	Cone Penetration Test
DCO	Development Consent Order
DP	Dynamic Positioning
EIA	Environmental Impact Assessment
EMF	Electromagnetic Fields
FO	Fibre Optic
GBS	Gravity Base Structure
HAT	Highest Astronomical Tide
HDD	Horizontal Directional Drilling
HRA	Habitat Regulations Assessment
HVAC	High Voltage Alternating Current
IAIA	International Association of Marine Aids to navigation and Lighthouses Authority
LAT	Lowest Astronomical Tide
O&M	Operation and Maintenance
OFTO	Offshore Transmission Owners
OOOMP	Outline Offshore Operation and Maintenance Plan
PEIR	Preliminary Environmental Information Report
PLGR	Pre-Lay Grapnel Run
PRoW	Public Rights of Way
ROV	Remotely Operated Vehicle
SAC	Special Area of Conservation
SCADA	Supervisory Control and Data Acquisition
SPA	Special Protection Area
SSSI	Special Site of Scientific Interest
TP	Transition Pieces
UXO	Unexploded Ordnance

Glossary of Terminology

Applicant	East Anglia ONE North Limited.
Construction consolidation sites	Compounds which will contain laydown, storage and work areas for onshore construction works. The HDD construction compound will also be referred to as a construction consolidation site.
Construction, operation and maintenance platform	A fixed offshore structure required for construction, operation, and maintenance personnel and activities.
Development area	The area comprising the Proposed Onshore Development Area and the Offshore Development Area
East Anglia ONE North project	The proposed project consisting of up to 67 wind turbines, up to four offshore electrical platforms, up to one construction, operation and maintenance platform, inter-array cables, platform link cables, up to one operational meteorological mast, up to two offshore export cables, fibre optic cables, landfall infrastructure, onshore cables and ducts, onshore substation, and National Grid infrastructure.
East Anglia ONE North windfarm site	The offshore area within which wind turbines and offshore platforms will be located.
European site	Sites designated for nature conservation under the Habitats Directive and Birds Directive, as defined in regulation 8 of the Conservation of Habitats and Species Regulations 2017 and regulation 18 of the Conservation of Offshore Marine Habitats and Species Regulations 2017. These include candidate Special Areas of Conservation, Sites of Community Importance, Special Areas of Conservation and Special Protection Areas.
Evidence Plan Process	A voluntary consultation process with specialist stakeholders to agree the approach to the EIA and the information required to support HRA.
Horizontal directional drilling (HDD)	A method of cable installation where the cable is drilled beneath a feature without the need for trenching.
Inter-array cables	Offshore cables which link the wind turbines to each other and the offshore electrical platforms, these cables will include fibre optic cables.
Jointing bay	Underground structures constructed at regular intervals along the onshore cable route to join sections of cable and facilitate installation of the cables into the buried ducts.
Landfall	The area (from Mean Low Water Springs) where the offshore export cables would make contact with land and connect to the onshore cables.
Link boxes	Underground chambers or above ground cabinets next to the cable trench housing electrical earthing links.
Met mast	An offshore structure which contains metrological instruments used for wind data acquisition.
Mitigation areas	Areas captured within the Development Area specifically for mitigating expected or anticipated impacts.
Monitoring buoys	Buoys to monitor *in situ* condition within the windfarm, for example wave and metocean conditions.

National Grid infrastructure	A National Grid substation, connection to the existing electricity pylons and National Grid overhead line realignment works which will be consented as part of the proposed East Anglia ONE North project Development Consent Order but will be National Grid owned assets.
National Grid overhead line realignment works	Works required to upgrade the existing electricity pylons and overhead lines to transport electricity from the National Grid substation to the national electricity grid
National Grid overhead line realignment works area	The proposed area for National Grid overhead line realignment works.
National Grid substation	The substation (including all of the electrical equipment within it) necessary to connect the electricity generated by the proposed East Anglia ONE North project to the national electricity grid which will be owned by National Grid but is being consented as part of the proposed East Anglia ONE North project Development Consent Order.
National Grid substation location	The proposed location of the National Grid substation.
Natura 2000 site	A site forming part of the network of sites made up of Special Areas of Conservation and Special Protection Areas designated respectively under the Habitats Directive and Birds Directive.
Offshore cable corridor	This is the area which will contain the offshore export cables between offshore electrical platforms and landfall jointing bay.
Offshore development area	The East Anglia ONE North windfarm site and offshore cable corridor (up to Mean High Water Springs).
Offshore electrical infrastructure	The transmission assets required to export generated electricity to shore. This includes inter-array cables from the wind turbines to the offshore electrical platforms, offshore electrical platforms, platform link cables and export cables from the offshore electrical platforms to the landfall.
Offshore electrical platform	A fixed structure located within the windfarm area, containing electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.
Offshore export cables	The cables which would bring electricity from the offshore electrical platforms to the landfall, these cables will include fibre optic cables.
Offshore infrastructure	All of the offshore infrastructure including wind turbines, platforms, and cables.
Offshore platform	A collective term for the construction, operation and maintenance platform and the offshore electrical platforms.
Onshore cable corridor	The corridor within which the onshore cable route will be located.
Onshore cable route	This is the construction swathe within the onshore cable corridor which would contain onshore cables as well as temporary ground required for construction which includes cable trenches, haul road and spoil storage areas.
Onshore cables	The cables which would bring electricity from landfall to the onshore substation. The onshore cable is comprised of up to six power cables and two fibre optic cables.
Proposed onshore development area	The area in which the landfall, onshore cable corridor, onshore substation, mitigation areas, temporary construction facilities (such as access roads and construction consolidation sites), and the National Grid Infrastructure will be located.

Onshore infrastructure	The combined name for all of the onshore infrastructure associated with the proposed East Anglia ONE North project from landfall to the connection to the national electricity grid.
Onshore substation	The East Anglia ONE North substation and all of the electrical equipment, both within and connecting to the National Grid infrastructure.
Onshore substation location	The proposed location of the onshore substation for the proposed East Anglia ONE North project.
Platform link cable	Electrical cable which links one or more offshore platforms, these cables will include fibre optic cables.
Safety zones	A marine area declared for the purposes of safety around a renewable energy installation or works / construction area under the Energy Act 2004.
Scour protection	Protective materials to avoid sediment being eroded away from the base of the foundations as a result of the flow of water.
Transition bay	Underground structures at the landfall that house the joints between the offshore export cables and the onshore cables.

6 Project Description

6.1 Introduction

1. This chapter provides a description of the components required for the construction, operation and decommissioning of the proposed East Anglia ONE North project and the methods of installation. This description provides the basis for the assessments provided in ***Chapters 7*** to ***30*** of this Preliminary Environmental Information Report (PEIR). The Applicant will continue to refine the design of the proposed East Anglia ONE North project prior to submission of the Development Consent Order (DCO) application and will update the information presented in the project description and assessment chapters of the PEIR for the Environmental Statement (ES) to be submitted as part of the DCO application.

2. A brief overview of the proposed East Anglia ONE North project is presented in ***section 6.2*** followed by an outline of the key project characteristics in ***section 6.3***. A detailed description of all aspects of the project is provided in ***sections 6.4*** to ***6.6*** which is divided into the following three areas:

- **Offshore** - wind turbines and associated foundations, offshore electrical platforms and associated foundations, offshore construction, operation and maintenance platform and associated foundations, a meteorological mast and its foundation, and offshore export cables, fibre optic cables, platform link cables and inter-array cables. This section also describes works required to construct and access these components;
- **Landfall** - bringing of offshore export cables ashore to connect to onshore cables within a transition bay which will provide maintenance access during operation; and
- **Onshore** - onshore cables, the onshore substation, National Grid infrastructure, highway improvements, landscaping and work to construct and access these components.

6.1.1 Project Design Envelope

3. ***Section 3.5*** of ***Chapter 3 Policy and Legislative Context*** provides a background to the project design envelope (or Rochdale envelope) approach.

4. The project design envelope sets out a series of realistic design assumptions from which worst case parameters are drawn for the proposed East Anglia ONE North project. The project design envelope has a reasoned maximum extent for a number of key parameters. The final design would lie within the maximum extent of the consent sought. The project design envelope is used to establish

the maximum extent to which the proposed East Anglia ONE North project could impact on the environment. The detailed design of the proposed East Anglia ONE North project could then vary within this 'envelope' without rendering the assessment inadequate

5. The general principle of the assessment is that for each receptor topic, the impact assessment is based on a range of project design parameters (e.g. the maximum tip height of wind turbines that could be installed would be 300m above lowest astronomical tide (LAT) with a maximum rotor diameter of 250m), the key being that those parameters selected represent the range of options within which the greatest environmental impact would occur. The end result is an Environmental Impact Assessment (EIA) based on clearly defined environmental parameters that would govern or define the full range of development possibilities and hence the likely environmental impacts that could flow from the grant of development consent.

6. Therefore, the information presented in this chapter covers the range of potential design parameters upon which the subsequent impact assessment chapters are based.

6.1.2 Project Description Terminology

7. This project description uses specific terms for different areas offshore and onshore. These terms are also used within the technical chapters (***Chapter 7 to Chapter 30***) and are outlined in the glossary on page v.

6.2 Consultation

8. The Applicant (who is a wholly owned subsidiary of ScottishPower Renewables (SPR)) has undertaken extensive pre-application engagement with stakeholders, communities and landowners in order to seek input to refine the project design (further information on this consultation will be provided within the Consultation Report to be submitted as part of the DCO application). Consultation has been conducted through various means as detailed in ***Chapter 5 EIA Methodology***, and through the Applicant's request for a formal Scoping Opinion from the Planning inspectorate which was supported by a Scoping Report (SPR 2017).

9. ***Table 6.1*** provides a summary of those consultation responses that have been received which are relevant to the project description.

Table 6.1 Consultation Responses

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
Norfolk County Council	01/11/2017 Scoping Response	The PEI will need to address whether the existing overhead lines and substation are sufficient to be able to	Infrastructure required to connect into the National Grid is

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		cope with the Wind Farm, or whether there will need to be any upgrading of any existing overhead power lines. The PEI should also address the cumulative impact on the Grid Network arising from any existing or proposed Wind Farm in the area.	described in ***section 6.7.9.***
Norfolk County Council	01/11/2017 Scoping Response	In the event that new power lines are needed (or existing power lines up-graded) or any other infrastructure needs up-grading (e.g. sub-station) there would need to be a description of the route(s) including plans at an appropriate scale incorporating, for example: • An assessment of their impact (e.g. photomontages etc); • Details of temporary construction compounds; and • Identification of any sensitive features along route. The PEI should consider the possibility of putting overhead power lines underground in order to minimise their impact.	
Suffolk Fire and Rescue Service	28/11/2017 Scoping Response	The Suffolk Fire and Rescue Service requests that early consideration is given during the design stage of the development for both access for fire vehicles and the provision of water for fire-fighting which will allow us to make final consultation at the planning stage'	This information will be included in the outline Design and Access Statement submitted as part of the DCO application.
Public Health England	05/12/2017 Scoping Response	The ES should clearly identify the development's location and the location and distance from the development of off-site human receptors that may be affected by emissions from, or activities at, the development. Off-site human receptors may include people living in residential premises; people working in commercial, and industrial premises and people using transport infrastructure (such as roads and railways), recreational areas, and	This information is detailed in ***sections 6.6-6.7*** of this chapter and also assessed within all relevant onshore technical ***chapters 18-27.***

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		publicly-accessible land. Consideration should also be given to environmental receptors such as the surrounding land, watercourses, surface and groundwater, and drinking water supplies such as wells, boreholes and water abstraction points.	
Maritime and Coastguard Agency	05/12/2017 Scoping Response	The turbine layout design will require MCA approval prior to construction to minimise the risks to surface vessels, including rescue boats, and Search and Rescue aircraft operating within the site. As such, MCA will seek to ensure all structures are aligned in straight rows and columns. Any additional navigation safety and/or Search and Rescue requirements, as per MGN 543 Annex 5, will be agreed at the approval stage	Finalised turbine layouts will be agreed with the MCA prior to construction and will be in line with MGN 543.
Maritime and Coastguard Agency	05/12/2017 Scoping Response	Particular attention should be paid to cabling routes and where appropriate burial depth for which a Burial Protection Index study should be completed and, subject to the traffic volumes, an anchor penetration study may be necessary. If cable protection are required e.g. rock bags, concrete mattresses, the MCA would be willing to accept a 5% reduction in surrounding depths referenced to Chart Datum. This will be particularly relevant where depths are decreasing towards shore and potential impacts on navigable water increase.	The requirement for cable protection is discussed in ***section 6.5.11***.
Maritime and Coastguard Agency	05/12/2017 Scoping Response	Any application for safety zones will need to be carefully assessed and additionally supported by experience from the development and construction stages.	Safety zones are discussed in ***section 6.5.12*** and in ***Chapter 13 Commercial Fisheries*** and ***Chapter 14 Shipping and Navigation.***
Marine Management Organisation	07/12/2017 Scoping Response	Operation and maintenance activities for EA2 have been included in the Scoping Report (Section 1.5.6: 'Operations and Maintenance	This chapter details Operations and Maintenance (***section 6.5.16***) activities and potential impacts of

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		Strategy'). The MMO recommends that operation and maintenance activities are fully detailed and that consideration is given to the potential impact of such works in the ES. Details within the 'Rochdale Envelope' should include the maximum number of operation and maintenance events, maximum frequency and the potential scope of the works, i.e. for export or inter-array cable repairs, turbine maintenance, etc.	these activities are considered within offshore technical ***chapters 7 - 17*** where relevant.
Marine Management Organisation	07/12/2017 Scoping Response	The MMO acknowledge that the impacts of dredging and disposal activities on the marine environment, including the composition of the material and potential disposal sites have been considered. However, a description of the dredging method and the amount of material that will be removed and to what depth will need to be provided. The 'Disposal Site for the Proposed East Anglia THREE Project Site Characterisation Document' submitted to the MMO for the East Anglia Three OWF project will need to be updated, taking account of the additional material proposed for disposal, which should include as a minimum: • The need for the new disposal site; • The dredged material characteristics; • The disposal site characteristics; • The assessment of potential effects and • The reasons for the site selection. Relevant chapters of the ES should provide sufficient information to inform the amended disposal site characterisation report, putting the evidence above into context with the proposed disposal site.	Potential dredging requirements are detailed in ***section 6.5*** A Site Characterisation Document will be provided for the proposed East Anglia ONE North project with the DCO application. Information on disposal sites is included in ***section 6.5.14***. The potential for contaminated sediment to be present within the offshore development area is discussed in ***Chapter 8 Marine Water and Sediment Quality.***

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
Marine Management Organisation	07/12/2017 Scoping Response	Dredge material destined for disposal within a designated site typically requires contaminant characterisation by a certified laboratory. Should characterisation results show the dredged material to be contaminated, the applicant would need to consider other disposal methods in line with the EU Waste Hierarchy Framework. Under certain circumstances contaminant testing may not be required for a licence determination, for example if there is sufficient evidence that the material comprises clean sand or gravel without any mud/silt fractions.	
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	Consider in-life operational (50 years?) maintenance of cables when assessing preferred method of cable landfall. For example, the risk of uncovering by erosion is greater with the beach buried option than HDD to lower level and offshore break out point. Consider the need to monitor beach levels and impact of vehicles on the beach required to re-bury cables if/ when uncovered. Will shallow cables impose constraints on use of beach by other vehicles if cables are uncovered or depth of coverage reduces? Shallow cables would also require the operator to monitor. Decommissioning impacts of different landfall installation methods must also be considered	Horizontal directional drilling (HDD) will be used to install the cable ducts at the landfall, avoiding impacts upon the beach. A full description of the location and methodology is provided in ***section 6.6***
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	It is not clear if the Applicant is proposing to reduce the number of turbines in the event that 19MW generators are used, clearly fewer turbines would be required to produce the same output in that case. The reduction in turbine numbers would be likely to reduce the environmental impacts of the scheme.	Turbine numbers and size of turbines is explained in ***section 6.3*** and ***6.5***
Natural England	08/12/2017	Natural England advises that a minimum offshore cable burial depth of 1m be achieved.	The preferred construction technique and depth of burial for

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
	Scoping Response		the offshore electrical infrastructure would be decided after the pre-construction geotechnical ground investigation is undertaken and a risk assessment and a lifetime maintenance assessment is completed. See ***section 6.5.11.3.***
Natural England	08/12/2017 Scoping Response	Natural England would welcome a clear description and assessment of the pros and cons of the scour and cable protection methodologies considered to ensure we achieve the best environmental option. This assessment should clearly present the full, but realistic extent of cable protection required. Consideration should be given to using protection that can be recovered on decommissioning if required i.e. mattresses that won't degrade, rock that can be recovered.	Scour and cable protection is discussed in ***sections 6.5.4*** and ***6.5.11.5.*** In addition, an Outline Scour and Cable Protection Plan will be submitted with the DCO appllication which will detail the scour and cable protection proposed for the project.
Natural England	08/12/2017 Scoping Response	Natural England advises that the use of HDD is the preferred method for the landfall installation as it will minimise environmental impact.	HDD will be used to install the cable ducts at the landfall, avoiding impacts upon the beach. A full description of the location and methodology is provided in ***section 6.6.***
The Environment Agency	08/12/2017 Scoping Response	Section 1.5.3 of the Scoping Report further discusses landfall, and the potential installation methods. It is noted that there is a SSSI present spanning the proposed landfall area, in addition to areas of intertidal habitats. The longer HDD option from transition	HDD will be used to install the cable ducts at the landfall, avoiding impacts upon the beach. A full description of the location and

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		bay locations would appear to be the preferred option in order to avoid impacting upon features including the Leiston-Aldeburgh SSSI (particularly those elements within it such as coastal vegetated shingle).	methodology is provided in ***section 6.6.***
The Environment Agency	08/12/2017 Scoping Response	Similarly, with regard to section 1.5.4 of the Scoping Report (onshore transmission works), it must be ensured that works are sited, as far as is practically possible, to avoid impacting upon the footprints of protected areas in the onshore area. The implications of jointing bays and the cable corridor must be considered well in advance to avoid ecological damage and disturbance, and to enable any necessary mitigation to be planned.	Considerations for the siting of onshore infrastructure are discussed ***in sections 6.6*** and ***6.7***
Natural England	08/12/2017 Scoping Response	Natural England welcomes the sharing of onshore substation compound works and mitigation between EA1N and EA2. Any publicly available information from the Sizewell C project should be used to inform the PEI.	Noted.
Natural England	08/12/2017 Scoping Response	Natural England queries why floating turbines are not being considered as a foundation option?	The Applicant does not consider the East Anglia ONE North windfarm site suitable for floating foundations
Natural England	08/12/2017 Scoping Response	We note that SPR is proposing to install ducting for the EA1N onshore electrical cables during the EA2 construction. We seek clarification that the cables will follow the same route and be constructed simultaneously within the onshore zone. If not, a more thorough cumulative ecology, and landscape and visual impact assessment is likely to be required.	Consent for the ducting for East Anglia ONE North onshore electrical cables during construction of those for East Anglia TWO will not be sought. Two scenarios for construction of the proposed East Anglia ONE North and East Anglia TWO projects are described, in which the projects are constructed together or

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
			sequentially (see ***Appendix 6.1***). The onshore cable corridor will accommodate both sets of cables and the substations will be co-located. Onshore cumulative impacts of the proposed East Anglia ONE North and East Anglia TWO projects are considered in technical ***chapters 18 – 30***.
National Grid	08/12/2017 Scoping Response	National Grid's Overhead Line/s is protected by a Deed of Easement/Wayleave Agreement which provides full right of access to retain, maintain, repair and inspect our asset	The Applicant is working closely with NGET both to develop the design of the National Grid infrastructure and to ensure all onshore infrastructure is sited and constructed in line with the required standards
National Grid	08/12/2017 Scoping Response	If a landscaping scheme is proposed as part of the proposal, we request that only slow and low growing species of trees and shrubs are planted beneath and adjacent to the existing overhead line to reduce the risk of growth to a height which compromises statutory safety clearances. □ Drilling or excavation works should not be undertaken if they have the potential to disturb or adversely affect the foundations or "pillars of support" of any existing tower. These foundations always extend beyond the base area of the existing tower and foundation ("pillar of support") drawings can be obtained using the contact details above □ National Grid Electricity Transmission high voltage underground cables are protected by a Deed of Grant; Easement; Wayleave Agreement or the provisions of the New Roads and Street Works Act. These provisions provide	

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		National Grid full right of access to retain, maintain, repair and inspect our assets. Hence we require that no permanent / temporary structures are to be built over our cables or within the easement strip. Any such proposals should be discussed and agreed with National Grid prior to any works taking place. Ground levels above our cables must not be altered in any way. Any alterations to the depth of our cables will subsequently alter the rating of the circuit and can compromise the reliability, efficiency and safety of our electricity network and requires consultation with National Grid prior to any such changes in both level and construction being implemented.	
National Grid	08/12/2017 Scoping Response	We would request that the potential impact of the proposed scheme on National Grid’s existing assets as set out above and including any proposed diversions is considered in any subsequent reports, including in the Environmental Statement, and as part of any subsequent application.	
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	Details of any site worker accommodation indicating; extent of use, number of workers accommodated, amenities and drainage, should be provided.	Details are provided in ***sections 6.6*** and ***6.7***.
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	A decommissioning plan, detailing all site reinstatements and removal of commercial waste, should be presented. Restoration will be key to a successful decommissioning plan.	S***ections 6.6*** and ***6.7.*** describe the works required for construction, operation and decommissioning of the proposed East Anglia ONE North project Reinstatement is covered in ***section 6.7.3.17*** for the

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
			onshore cable route and grading and earthworks at the substations covered in ***section 6.7.8***. Information regarding the management of waste is provided in ***Chapter 18 Ground Conditions and Contamination***.
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	More detailed information related to all licensed contractors and disposal facilities used for the movement and storage of waste materials during the construction of this development. This should be provided in addition to the requirements of the Environment Agency.	Further detail regarding the management of waste material can be found in ***Chapter 18 Ground Conditions and Contamination.***
Suffolk County Council & Suffolk Coastal District Council	08/12/2017 Scoping Response	A haul road is proposed with a 50m working width. Is a constructed haul road necessary or could temporary tracking be used? This is queried as there is a massive length of haul road being installed for EA One, which could be replaced for the most part with the use of temporary tracking and tracked vehicles (depending on soil conditions). Positioning jointing bays near to road access would enable any haul road to be kept to a minimum. Installing a haul road results in additional vehicles and importation of materials and takes time and has a cost involved that could be minimised and possible environmental impacts avoided.	The working width for East Anglia ONE North's onshore cable route will be up to 32m, this will encompass the trenches, temporary haul road and spoil storage. The EIA will be based on a worst case scenario whereby the full length of the onshore cable route requires temporary haul road which provides flexibility.
The Planning Inspectorate	20/12/2017 Scoping Response	Paragraph 180 of the Scoping Report states that major accidents and disasters will be considered in the EIA in the context of how the Proposed Development is designed and the measures in place in case of emergency, for example, in relation to pollution prevention and response. The EIA should also identify if the Proposed	Noted, this is discussed in ***section 6.12*** which describes the response to potential major accidents and disasters both onshore and offshore.

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		Development itself has the potential to cause major accidents or disasters during construction, operation or decommissioning.	
The Planning Inspectorate	20/12/2017 Scoping Response	The Applicant should make every attempt to narrow the range of options and explain clearly in the ES which elements of the Proposed Development have yet to be finalised and provide the reasons. At the time of application, any Proposed Development parameters should not be so wide-ranging as to represent effectively different developments. The development parameters will need to be consistently and clearly defined in both the draft DCO (dDCO) and in the accompanying ES. It is a matter for the Applicant, in preparing an ES, to consider whether it is possible to robustly assess a range of impacts resulting from a large number of undecided parameters. The description of the Proposed Development in the ES must not be so wide that it is insufficiently certain to comply with the requirements of Regulation 14 of the EIA Regulations.	This chapter provides a detailed description of the design envelope at this PEIR stage.
The Planning Inspectorate	20/12/2017 Scoping Response	The Inspectorate understands that at this stage the extent of the Proposed Development site, both offshore and onshore, is not yet determined, however reminds the Applicant that the PEI should include a discrete section that fully describes both parts of the site.	Both onshore and offshore aspects are detailed within this chapter in ***sections 6.5*** and ***6.7***.
The Planning Inspectorate	20/12/2017 Scoping Response	Section 1.5.1 of the Scoping Report indicates that both a meteorological mast and LIDAR buoys are expected to comprise key offshore components of the Proposed Development; however, Section 1.5.2 paragraph 79 indicates that one or the other would be utilised. It is stated in Table 1.3 that there would be two offshore export cables while Section 1.5.3 notes that one transition bay would be needed for each offshore	Noted. The number and type of buoys (including Lidar) to be used are described in ***section 6.5.7*** and ***6.5.8*** and the meteorological mast is described in ***section 6.5.6***

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		cable and there would be 'up to' two transition bays. The description of the Proposed Development must be consistent throughout the ES, notwithstanding that alternative options may be presented.	
The Planning Inspectorate	20/12/2017 Scoping Response	The description of the Proposed Development in Section 1.5 of the Scoping Report includes a fleeting reference to offshore fibre optic communications cables and the need for link boxes housing joints. However, other than a brief reference to potential impacts of the link boxes in the traffic and transport chapter (paragraph 614) these components are not discussed elsewhere in the Scoping Report. The description of the Proposed Development in the PEI must be comprehensive, and an assessment of the potential impacts of the construction, operation and decommissioning of all of its component parts must be carried out.	Separate link boxes will be buried adjacent to the jointing bays. Offshore, fibre optic cables will either be incorporated within export, inter-array and platform link cables or secured to the outside of these. Onshore, fibre optic cables will be laid adjacent to the electrical cables or installed within the electrical cable ducts.
Leiston-cum-Sizewell Town Council	21/12/2017 Scoping Response	The two substations specified are too high (21m) and the National Grid compound, along with these two stations seem to take up a very substantial area indeed – much more than the Gabbard and Galloper substations which we fought so hard to incorporate into our precious landscape. Surely these can be reduced?	The maximum building height at the onshore substation would be 15m above ground level with external electrical equipment up to 18m above ground level (see ***section 6.7.7***). The operational footprints of the onshore substation and National Grid substation will be reviewed through the detailed design phase of the project post-consent.
Leiston-cum-Sizewell Town Council	21/12/2017 Scoping Response	All the expected impacts seem to be covered but noise levels during construction and most certainly during	More information on potential noise impacts and proposed mitigation measures are detailed in ***Chapter***

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		operation must be clearly predicted and mitigated for to a very high level.	***25 Noise and Vibration.***
Leiston-cum-Sizewell Town Council	21/12/2017 Scoping Response	Crossing the B1122 seems, to the layman, to be a complicated exercise and one that will need careful explanation to the residents along that road – the scoping report should layout how drilling under accommodation affects properties and prove just how safe an underground cable (under your home) is.	Road crossing methods are discussed in ***section 6.7.3.10***. No cables will be installed beneath residential property.
EDF Energy	22/12/2017 Email correspondence	As operator of the Sizewell B nuclear power station, EDF Energy has responsibilities for emergency planning under the Nuclear Site License conditions attached to SZB. EDF Energy has to be sure that any development within the emergency planning zone can be accommodated within the off-site emergency plan. Part of the EA1N and EA2 study area falls within this emergency planning zone. This means that measures would need to be put in place to ensure that the needs of staff, visitors and residents in the area have been addressed from an emergency planning point of view. EDF Energy would be pleased to discuss this matter with SPR and share its expertise on any potential issues.	The Applicant is in ongoing consultation with EDF. The PEIR and subsequently the ES and DCO application will provide further detail to EDF Energy on the proposed East Anglia ONE North project.
EDF Energy	22/12/2017 Email correspondence	EDF Energy must ensure its ongoing compliance with the provisions of the Nuclear Site License for SZB. We, therefore, expect SPR to cooperate fully and address any concerns, where appropriate, to ensure that there would be no adverse impact on the day-to-day running, security and safety of SZB. EDF Energy requires an opportunity to comment on the technical details of proposals, with specific regard to onshore operational assets including the access route to SZB (Sizewell Gap Road) and the adjacent utilities, the overhead 400kV lines, the emergency control centre and any aspects of the	For emergency response procedures see ***section 6.12***.

Consultee	Date / Document	Comment	Response / where addressed in the PEIR
		proposed development that could impact on these key assets (eg drainage and methods of work)	
EDF Energy	22/12/2017 Email correspondence	SPR should also be aware that EDF Energy has the benefit of a bilateral agreement with the National Grid, entitled the Nuclear Site Licence Provisions Agreement (NSLPA). This agreement ensures that the NG advises EDF of new connection arrangements and evaluates any consequential changes to the reliability, quantum and quality of supply to our nuclear power stations, both during our construction and operational phases. For this part of the process it will be necessary for SPR to provide NG with further details of the plant, and equipment proposed for the connection to ensure that the SZB nuclear safety case is not compromised. Clearance of the associated Engineering Change proposals will also be required prior to any connection and energisation of new assets to the transmission system.	National Grid will engage with EDF Energy in this regard and the Applicant is liaising with National Grid.
EDF Energy	22/12/2017 Email correspondence	EDF Energy will seek to ensure that any proposals, including EA1N and EA2 would not prejudice the future development plans, including areas up to the Sizewell Gap Road.	Information presented in this PEIR, and subsequently within the ES and DCO will provide EDF Energy with details of the Applicant's proposals.
EDF Energy	22/12/2017 Email correspondence	Whilst we understand that the start dates for EA1N and EA2 are indicative, it is likely that the construction period will coincide with that of SZC. EDF would expect the relevant ES to cover the potential in-combination effects	In-combination and cumulative effects are considered in each technical chapter as appropriate. Any new information will be taken in to account in the DCO application.

10. Ongoing public consultation has been conducted through a series of Public Information Days (PIDs) and Public Meetings. PIDs have been held throughout Suffolk in November 2017, March 2018 and June / July 2018 with further events

planned in 2019. A series of stakeholder engagement events were also undertaken in October 2018 as part of consultation phase 3.5. These events were held to consult on potential changes to the onshore substation location. This consultation aims to ensure that concerns are well understood and that site specific conditions can be taken into account, where practicable. Details of the consultation phases are discussed further in ***Chapter 5 EIA Methodology***. A summary of the public consultation undertaken is published on the East Anglia ONE North project website.

6.3 Overview of the Project

11. The proposed East Anglia ONE North project would consist of up to 67 wind turbines, with a total installed capacity of up to 800MW. For the purposes of establishing the worst case scenarios in this PEIR, two indicative wind turbine models have been considered; a '250m' and '300m' which refers to each models' maximum blade tip height. The parameters associated with each represent the lower and upper range of parameters within the Rochdale Envelope, respectively. The maximum wind turbine hub height used would be 175m (above LAT) with maximum rotor diameter of 250m. It is possible that more than one wind turbine model within the consented parameters would be used.

12. A construction, operation and maintenance platform (O&M) platform may be installed within the East Anglia ONE North windfarm site which would provide accommodation for the construction and maintenance work force. There is also potential for the installation of one meteorological mast.

13. Up to four High Voltage Alternating Current (HVAC) offshore electrical platforms (connected by platform link cables) would be installed offshore and would collect electricity from the wind turbines through a network of inter-array cables to then transport it to shore via up to two offshore export cables (each buried within a separate trench) **(*Figure 6.1*).** All of the offshore cables would also include fibre optic (FO) cables either within the cables themselves or secured to the outside.

14. Once the offshore export cables enter the underground transition bay at the landfall, they will be joined to the onshore cables. There will be up to six single core onshore cables and up to two FO cables (a total of eight cables). The onshore cable corridor shall follow the route shown in ***Figure 6.2***.

15. From the landfall, cables will be routed underground to an onshore substation which will in turn connect into the main transmission network via a National Grid substation to be owned and operated by National Grid connecting into the existing overhead pylons. In addition, there will be a requirement to undertake upgrades to the existing pylons within the National Grid overhead line realignment works area. This will require the installation of one additional pylon to allow connection to the transmission network via new cable sealing ends.

16. The proposed East Anglia ONE North project and the proposed East Anglia TWO project are being developed in parallel but they will be submitted as two separate DCO applications. The assessment presented in this PEIR will assess the impacts of the proposed East Anglia ONE North project alone and, through the use of appropriate assessment scenarios, the potential cumulative impacts with the proposed East Anglia TWO project.

17. The proposed onshore development area has been developed to allow for the construction of both the proposed East Anglia ONE North and East Anglia TWO projects. At this stage, it is not known whether both projects would be constructed simultaneously or sequentially. Therefore, the onshore topic assessments (***Chapters 18 – 27***) include two cumulative assessment scenarios which are considered to represent the two worst case scenarios for construction of the onshore infrastructure.

18. Scenario 1 will assess the impacts of both the proposed East Anglia ONE North and East Anglia TWO projects being built simultaneously (i.e. at the same time). Scenario 2 will assess the impacts of the proposed East Anglia ONE North and East Anglia TWO projects being built sequentially (i.e. the proposed East Anglia TWO project being built prior to the proposed East Anglia ONE North project). For the onshore infrastructure Scenario 2 assumes construction of the proposed East Anglia TWO project and full re-instatement of the construction works, followed by the construction of the proposed East Anglia ONE North project. It should be noted that overlapping programmes are covered by these two scenarios.

19. ***Appendix 6.1*** covers the differences for these two scenarios relevant to the project description.

6.4 Key Project Characteristics

20. This section summarises the key characteristics of the project design. The key offshore components of the proposed East Anglia ONE North project will comprise:

- Offshore wind turbines and their associated foundations;
- Offshore platforms - up to four offshore electrical platforms and their associated foundations supporting some of the windfarm's electrical equipment, and up to one construction, operation and maintenance platform and associated foundations that may cater for personnel and activities required during the construction phase and operation and maintenance of the windfarm;
- Sub-sea cables between the wind turbines and between wind turbines and offshore electrical platforms (inter-array), between separate offshore

platforms (platform link cables) and between offshore electrical platforms and the landfall (export cables);

- Scour protection around foundations and on inter-array, platform link and export sub-sea cables as required; and
- Potential for one meteorological mast (met mast) and its associated foundations for monitoring wind speeds during the operational phase of the windfarm.

21. The key onshore components of the proposed East Anglia ONE North project, including infrastructure required by National Grid to connect the proposed East Anglia ONE North and East Anglia TWO projects to the electricity transmission network, will comprise:

- The landfall site with an associated transition bay to connect the onshore and offshore cables;
- Up to six onshore cables and up to two fibre optic cables, associated jointing bays and associated distributed temperature sensing (DTS) cabling (some or all of which may be installed in ducts);
- Onshore substation;
- Electrical cable connection between onshore substation and National Grid substation;
- National Grid substation;
- Sealing end compounds / gantries; and
- Potential for the upgrade of existing overhead pylons within the Proposed Development Area in proximity to the East Anglia ONE North onshore substation and National Grid substation, including the addition of one new pylon in close proximity to existing overhead pylons.

6.5 Offshore

6.5.1 Offshore Site Description

22. The East Anglia ONE North windfarm site is located in the southern North Sea approximately 36km from its nearest point to the port of Lowestoft and 42km from Southwold. The East Anglia ONE North windfarm site and the offshore cable corridor are shown in ***Figure 6.1*** and the proposed onshore development area is shown in ***Figure 6.2***. ***Table 6.2*** presents distances from the boundary of the East Anglia ONE North windfarm site to settlements along the UK coastline and to the nearest point of land in the Netherlands and Belgium.

Table 6.2 Distances from the Nearest Point of the East Anglia ONE North Windfarm Site to Other Selected Geographical Locations

Geographic Location	Distance from East Anglia ONE North Windfarm Site (km)
Lowestoft	36
Southwold	42
Sizewell	51
Orford	60
Netherlands (nearest point to coast)	107
Belgium (nearest point to coast)	120

23. The East Anglia ONE North windfarm site will cover an area of approximately 208km^2. Water depths within the site range from 33 to 67m (relative to the LAT) with depth generally increasing in the west.

24. The proposed East Anglia ONE North project includes one potential offshore cable corridor route from the landfall to the East Anglia ONE North windfarm site (***Figure 6.1***). The route passes to the north of the Southwold Aggregates Area and Southwold Transhipment Area.

6.5.2 Offshore Project Details Summary

25. This section details the characteristics of the offshore elements of the proposed East Anglia ONE North project. Key characteristics are listed in ***Table 6.3*** below and are discussed in more detail separately within the text.

Table 6.3 Offshore Parameters

Parameter	Characteristic
Number of wind turbines	Up to 67
East Anglia ONE North windfarm site area	208km^2
East Anglia ONE North windfarm site water depth range	33 - 67m (LAT)
Distance from East Anglia ONE North windfarm site to shore (closest point of site to Lowestoft)	36km
Maximum offshore cable corridor area	133km^2
Maximum number of export cables (HVAC)	Two
Maximum cable lengths	• Inter-array – 200km • Platform link – 75km

Parameter	Characteristic
	• Export – 152km
Maximum wind turbine rotor diameter	250m
Maximum wind turbine hub height (LAT)	175m
Maximum wind turbine tip height (LAT)	300m
Minimum clearance above sea level	22m (MHWS)
Minimum separation between wind turbines	In-row spacing: 800m
	Inter-row spacing: 1200m
Maximum number of wind turbine models to be installed	Three
Wind turbine foundation type options	Jacket, gravity base structure, suction caisson, jacket on suction caisson, monopile
Number of met masts	One
Maximum height of met mast (LAT)	175m
Met mast foundation type options	Jacket, gravity base structure, suction caisson, jacket on suction caisson, monopile
Number of offshore electrical platforms	Up to four
Number of construction, operation and maintenance platforms	One

6.5.3 Wind Turbines

26. The maximum wind turbine hub height used would be 175m (above LAT) with maximum rotor diameter of 250m and therefore a maximum tip height of up to 300m (above LAT).

27. Each wind turbine will comprise a tubular steel tower atop a foundation structure, a nacelle secured at the top of the tower and a rotor with three blades rotating around a horizontal axis. ***Plate 6.1*** presents a typical wind turbine; the dimensions of various characteristics of the wind turbines to be used would be within the range shown in ***Table 6.3****.*

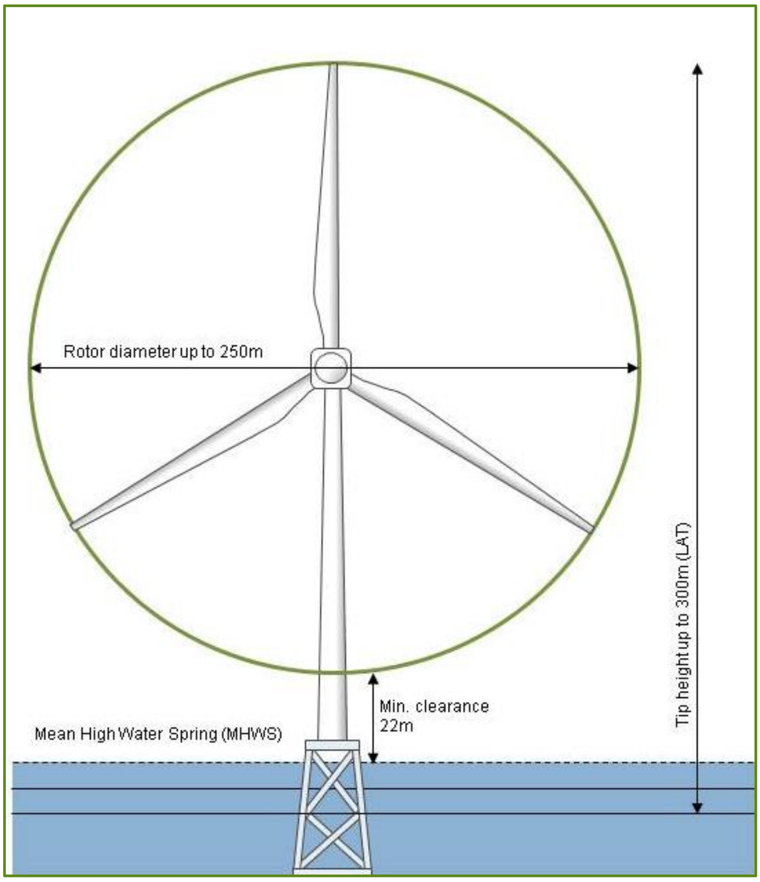


Plate 6.1 Key Dimension of the Proposed Offshore Wind Turbines

28. The nacelle contains mechanical and electrical generating components, an example is displayed in ***Plate 6.2****.*

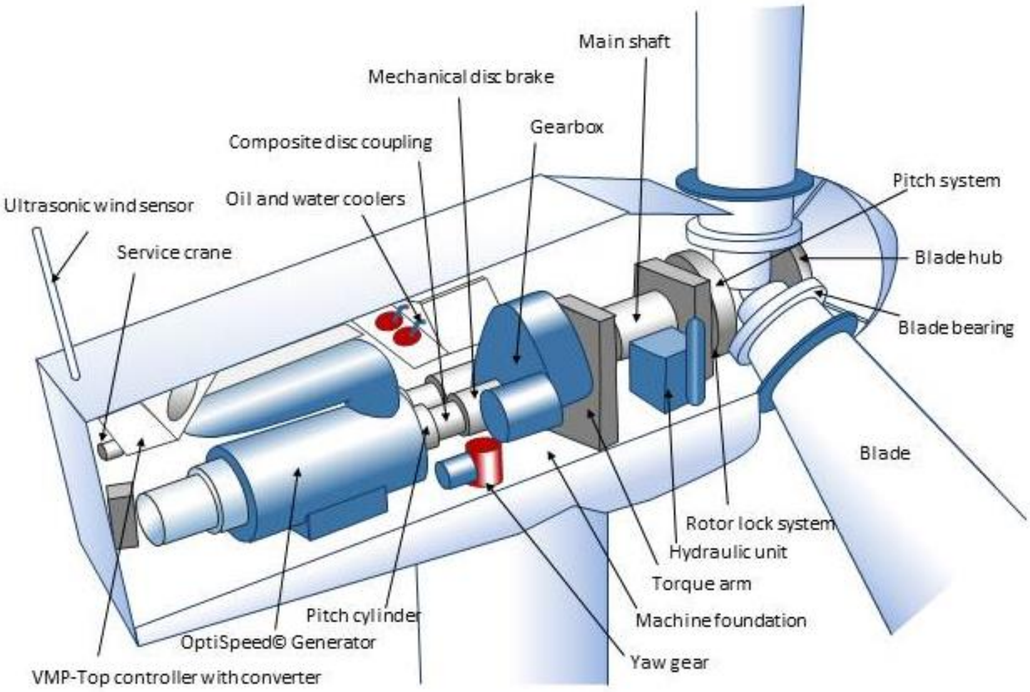


Plate 6.2 An example of internal Workings of a Wind Turbine Nacelle

6.5.3.1 Wind Turbine Layout

29. The layout of the East Anglia ONE North windfarm site, including wind turbines, inter-array, platform link cables and offshore platform locations have not yet been specified. Therefore, exact locations will not be included in the DCO application. This is due to the requirement for flexibility on layout pending further ground investigation, detailed design and commercial negotiations, and is one of the purposes of developing a project design envelope (as outlined in ***section 6.1.1)***. In developing the final layout, the Applicant would aim to minimise environmental impacts (e.g. through micro-siting) and impacts to other users whilst maximising energy yield and cost efficiency.

30. There is potential that the site would host more than one wind turbine type, with a maximum of three different models. At this stage, wind turbine types have not been determined.

31. The wind turbine layout can be described in general terms at this stage. It would have some form of regularity in plan, i.e. wind turbines would be set out in rows. The minimum separation between wind turbines is:

- In-row spacing – 800m; and
- Inter-row spacing – 1,200m.

32. The in-row spacing is the distance separating wind turbines in the main rows, which are generally orientated perpendicular to the prevailing wind, or as close to this as is practical. Inter-row spacing is distance between the main rows. In-row spacing and inter-row spacing (spacing between rows) may vary across the site area. Minimum separation distances are included to allow for any micrositing requirements due to, for example, seabed conditions or obstacles. The nominal separation distances are anticipated to be greater.

33. It should also be noted there may be empty spaces within the windfarm. This could be for wake recovery but more likely due to less favourable ground conditions, e.g. locations with large mobile sand waves.

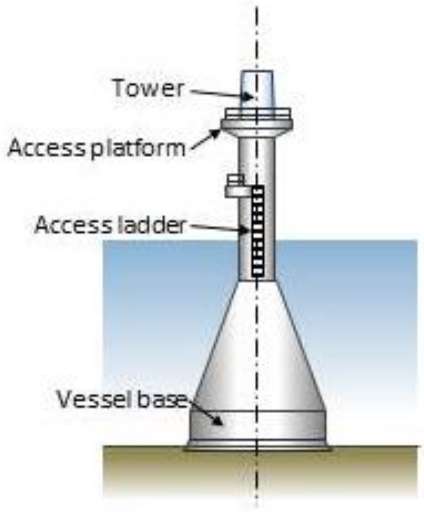
34. ***Chapter 14 Shipping and Navigation*** and the Navigational Risk Assessment (NRA***, Appendix 14.1***) that underpins that assessment is based on a 67 wind turbine layout.

35. The worst-case layout assessed for ***Chapter 28 Seascape, Landscape and Visual Impact Assessment*** is the layout associated with 53 x 300m wind turbines, as shown in ***Figure 28.1***. This layout has the highest wind turbine blade tip height (300m), with largest rotor diameter (250m), with a lower overall number of wind turbines (compared to a 67 250m wind turbine model layout) with wind turbine rows oriented in a realistic grid alignment. The realistic worst case for the SLVIA assessment has turbines spaced evenly within the East Anglia ONE North windfarm site in a regular pattern (***Figure 28.1***). The Rochdale Envelope would allow for wind turbines to be spaced closer together however this is not considered the worst case for assessment.

6.5.4 Foundations

36. ***Plate 6.3*** to ***Plate 6.6*** below illustrate typical wind turbine foundation types under consideration. The foundation types currently being considered for use are:

- Three or four-leg jackets on piles;
- Gravity base structures;
- Suction caissons;
- Three or four-leg jackets on suction caissons; and
- Monopiles.



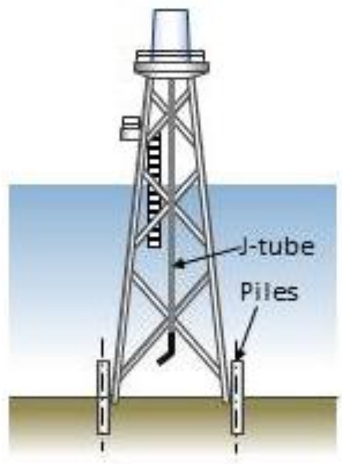
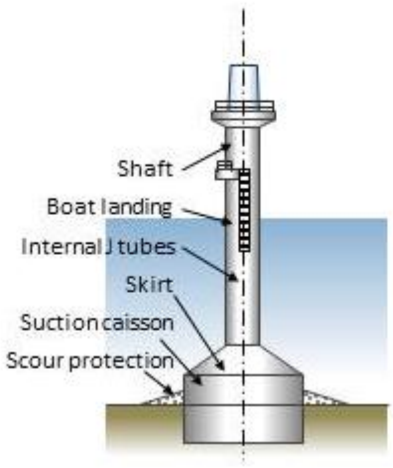


Plate 6.3 Typical Gravity Based Structure

Plate 6.4 Typical Jacket



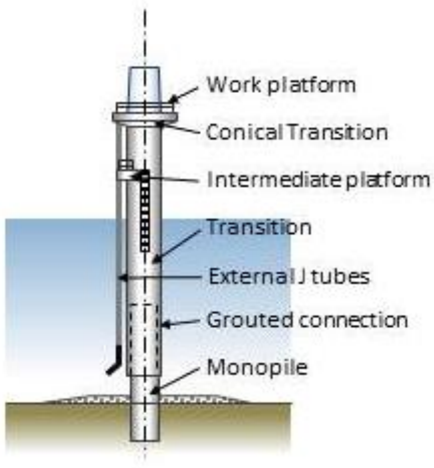


Plate 6.5 Typical Suction Caisson

Plate 6.6 Typical Monopile

37. Foundation types would be selected following detailed design, based on suitability of the ground conditions, water depths and wind turbine models. There may be only one type used, or a combination of foundation types may be used across the East Anglia ONE North windfarm site.

38. On top of the foundations would be a platform known as a transition piece. The transition piece facilitates the connection between the foundation and the tower.

39. Foundation components would be manufactured onshore and delivered to site as close to fully assembled as practical. Pin piles, if used, would be installed separately and attached to the main structure at the offshore location. Monopile

foundations, if used, would be installed first with surface structures lifted into place.

40. Fabrication, construction methods and requirements would all differ significantly depending on the foundation type selected.

6.5.4.1 Jacket Foundations

41. There are many variants of the jacket structure but there are three main categorisations:

- Pre-piled or post-piled;
- Three-legged or four-legged; and
- Straight or battered (angled) legs.

42. Maximum footprint sizes are outlined in ***Table 6.4*** below. The dimensions between pin pile centres are based on a square footprint.

Table 6.4 Four Pile Jacket Dimensions

Wind turbine model	Maximum leg spacing at seabed (m)	Maximum footprint size (m^2)
250m	45 x 45	2,025
300m	53 x 53	2,767

43. Pin pile penetrations for jacket foundations could be up to 65m depth below sea bed. Pin piles are generally expected to be driven but drilling may be required at some locations with harder ground conditions. Other techniques, such as vibration, may also be required at some locations. This would be decided following pre-construction geotechnical surveys and receipt of interpretative reporting. Pin-pile size would vary depending on the specific design but is expected to be up to 4.6m in diameter. Pin piles are usually installed vertically but concepts are being considered that install piles on a batter (at an angle).

44. Suction caisson foundations could be used at the base of the jacket instead of pin piles. This is considered in ***section 6.5.4.3***.

6.5.4.1.1 Materials required for jacket foundations

45. Jacket foundations are usually made of steel, although some secondary structures, such as handrails, gratings and ladders, could be produced using other metals, such as aluminium, or composites. Also, concrete could be used at the top of the jacket structure as part of a transition piece arrangement or just to form the working platform. The connection between the jacket structure and piles is often formed using cement grout.

6.5.4.1.2 Sea bed preparation and penetration for jacket foundations

46. Depending on the jacket concept and installation method selected, there may be a requirement to carry out minor seabed preparation at some locations to provide a more level formation for placement of a pile installation template. ***Table 6.5*** outlines two scenarios, based on a single 250m and a single 300m wind turbine model on a jacket base structure with a required seabed preparation depth of 5m.

Table 6.5 Estimated Dimensions of Sea Bed Preparation for Four Pile Jacket Foundations

Wind turbine model	Maximum area for seabed preparation per wind turbine (m^2)	Maximum volume of sediment removed per wind turbine (m^3)
250m	5,738	19,125
300m	6,603	22,405

6.5.4.1.3 Installation method of piled jacket foundations

47. For jacket foundations, the pin piles could be pre-piled (before the jacket structure is placed on the sea bed) or post-piled. It is anticipated that pin piles would generally be driven but alternative installation techniques, i.e. drilling or vibration, may be required depending on ground conditions. More novel pile solutions, e.g. screwpiles, would also be considered.

48. For pre-piled jackets, the overall installation methodology would typically be as follows:

- Confirmation investigation of the sea bed to ensure no obstructions are present (this would be on-going throughout the installation process);
- Undertake seabed preparation and install scour protection (if required);
- Pin piles and pin pile installation template transported to site via barge or installation vessel;
- Vessel (likely a jack-up rig) with pile installation equipment and heavy craneage set up at pile installation location;
- Pin pile installation template placed on sea bed;
- Pin piles placed on sea bed within template and driven to depth;
- Pin pile installation template recovered;
- Installed pin pile locations surveyed and jacket dimensions adjusted;
- Delivery of jacket to site via barge or installation vessel;
- Lifting of jacket onto installed pin piles via heavy lift or jack-up vessel; and
- Levelling of jacket, grouting and / or mechanical locking of jacket-to-pile connections.

49. For post-piled jackets, the sequence would typically be as follows:

- Jackets and piles transported to site via barge or installation vessel;
- Jack-up or heavy lift vessel with pile installation equipment and heavy craneage set up at jacket installation location;
- Sea bed preparation carried out if required;
- Lifting of jacket from barge or installation vessel and then lowering of the jacket onto sea bed;
- Lifting of pin piles from barge and placement into sleeves on jacket;
- Pin piles allowed to naturally penetrate seabed (stabbing);
- Pin piles driven to depth using pilling hammer;
- Levelling of jacket via jacking off piles; and
- Grouting and / or mechanical locking of jacket to pile connections.

50. It has been estimated that the maximum hammer driving energy required to drive a pin pile with a diameter of 4.6m is 2,400kJ.

6.5.4.1.4 Spoil removal and disposal for jacket foundations

51. For jacket foundations, the amount of spoil requiring disposal is likely to be limited.

52. Some dredging may be required for levelling the sea bed prior to the installation of a pile template (if used) as outlined in ***Table 6.5***. It should be possible to spread this material close to the installation works.

53. Based on preliminary geotechnical information, it is thought likely that pile driving would be possible across the whole East Anglia ONE North windfarm site; this would be confirmed at the pre-construction phase. Pin pile driving is unlikely to generate spoil material. However, until more detailed geotechnical assessments are carried out, the possibility of drilling must be considered at some locations. Drilling would generate some spoil material that would require removal and disposal. With a maximum drill penetration depth of 65m and a maximum drill diameter of 4.6m, each pile would potentially produce a volume of 1,080m^3 of drill arisings. It is proposed the spoil would be disposed of within the East Anglia ONE North windfarm site (see ***section 6.5.14***), adjacent to each location from where the material was derived, with the spoil subsequently winnowed away by the natural tide and wave driven processes.

6.5.4.1.5 Type of scour protection for (all) jacket foundations

54. The requirement for scour protection cannot be ruled out at this stage until the jacket designs are developed further and the scour risks have been quantified.

Scour protection could include, but is not limited to, rock armour, rock filled bags, pre-cast concrete block mattresses, tyre filled nets and rubber mats.

55. ***Table 6.6*** gives the foundation footprint sizes with the inclusion of scour protection, the form and scale of which will be decided following pre-construction surveys.

Table 6.6 Four Pile Jacket Foundations Footprint Dimensions with and without Scour Protection

Wind turbine model	Maximum footprint size (m^2)	Maximum footprint size with scour protection (m^2)
250m	2,025	4,726
300m	2,767	5,331

6.5.4.1.6 Decommissioning of jacket foundations

56. The overall removal methodology for jacket foundations would typically be as follows:

- Removal of wind turbine, met mast, switchgear and ancillaries, and cutting of cables (leaving buried inter array cables *in-situ*);
- Local jetting and / or suction around legs of jacket to a depth of approximately 1 to 2m;
- Deployment of underwater remote abrasive cutting equipment from service vessel;
- Mobilisation of heavy lift Dynamic Positioning (DP) vessel or jack-up rig and attachment of crane slings to jacket;
- Abrasive cutting of piles at a depth of approximately 1 to 2m below the sea bed;
- Lifting of jacket by crane on DP vessel or jack-up rig onto barge; and
- Transportation of jacket to port and dry dock for dismantling and reuse and recycling where possible.

57. It should be noted that it would not be intended to reinstate the local excavations remaining at the pile leg locations as it is anticipated that this would refill naturally over time.

6.5.4.2 Gravity Base Structures

58. There are many possible shapes and sizes being proposed by manufacturers for gravity base structures. Gravity base structures (GBS) usually comprise a base, a conical section and a cylindrical section *(**Plate 6.3**)*. One of the main factors affecting size would be whether the structure is to be transported on a barge or

vessel and lifted into place or whether it would be floated or semi-floated with the assistance of a barge or pontoon.

59. Most types of GBS are similar in form. Usually the base is hexagonal, octagonal or circular. Bases with a cruciform plan shape are also being considered, occupying a similar footprint.

60. Footprint sizes for the base are outlined in ***Table 6.7***.

Table 6.7 Gravity Base Structure Dimensions

Wind turbine model	Maximum base diameter (m)	Maximum footprint size (m^2)	Maximum footprint size with scour protection (m^2)
250m	53	2,206	19, 856
300m	60	2,827	25,447

61. For conical base GBS, the top of the base is usually 1 to 2m above the sea bed or slightly more if a bedding layer is used to provide a level formation. However, in areas where sand waves are present, it is possible that the top of the base would be installed below sea bed level.

62. For flat base GBS with only a cylindrical shaft, the top of base could be up to 10m above sea bed level.

6.5.4.2.1 Material required for GBS

63. GBS are generally concrete with steel reinforcement and pre-stressing strand. There are also hybrid concepts that include a steel tower. Secondary structures, such as handrails, gratings, fenders and ladders, would be produced using steel (or possibly another metal or composite material). The working platform could also be made from steel.

64. The ballast material used is commonly sand. Other materials may be considered as an alternative, such as olivine, dolerite, basalt or pig iron. However, it is most likely that sand dredged locally to the site would be used, depending on the suitability of the material.

6.5.4.2.2 Sea bed preparation and penetration for GBS

65. GBS may require sea bed preparation to level the sea bed, provide a base with adequate bearing capacity and to ensure adequate contact between foundation base and sea bed.

66. Sea bed preparation would consist of dredging works to level the seabed and the installation of a bedding and levelling layer. The dredging works are likely to be carried out using a trailer suction hopper dredger. After seabed levelling of the

bedding and levelling layer installation would be undertaken using a fall pipe vessel.

67. GBS foundations will be located and microsited to minimise ground preparation. ***Table 6.8*** below shows two scenarios based on a 250m and 300m wind turbine model on a GBS with a seabed preparation depth of 7m.

Table 6.8 Estimated Dimensions of Sea Bed Preparation for GBS

Wind turbine model	Maximum area for seabed preparation per wind turbine (m^2)	Maximum volume of sediment removed per wind turbine (m^3)
250m	6,650	22,585
300m	7,500	25,875

68. GBS may also use a skirt at their base which penetrates the sea bed giving more stability to the structure. The penetration could vary from 0.1 to 5m depending on ground conditions. Under-base grouting may also be used to strengthen the soil beneath the foundation and fill small voids.

6.5.4.2.3 Installation method of GBS

69. A GBS would be delivered to site via one of two methods, depending on the foundation design:

- Floating – towed to site using a vessel and sunk using ballast material; or
- Transported to site by barge and installed by heavy lift crane.

70. For the first solution, it is possible that a bespoke barge would be used to support the foundation during its towed journey to site. For the second solution, it is likely that a heavy lift vessel would be required to perform the installation. This could be a jack-up or floating vessel.

71. The installation of GBS is dependent on design and fabrication methods. Definitive methodology for installation would be finalised following the completion of post-consent commercial and technical discussions.

72. The overall installation methodology would typically be as follows:

- Confirmation investigation of sea bed to ensure no obstructions are present (this would be on-going throughout the installation process);
- Prepare sea bed (if necessary);
- GBS transported to site via barge or floated to site, hauled by tugs;
- Mobilise heavy lift floating crane (if foundation is non-buoyant solution);

- Lift foundation from barge and lower to prepared area of sea bed, or adjust buoyancy of floating foundation and sink to prepared area of sea bed;
- Install ballast as necessary; and
- Install scour protection (likely to be rock dumping).

73. Ballast works would be undertaken by a trailer suction hopper dredger. The scour protection works would typically be installed by a DP rock dumping vessel equipped with a fall pipe. The scour materials would be placed in one or multiple layers.

6.5.4.2.4 Spoil removal for GBS

74. Spoil removal would be undertaken as previously outlined in ***section 6.5.4.1.4.***

75. It would be preferable to use some of this material as ballast but in an extreme case all of it may need to be disposed of if it is unsuitable for ballast. The suitability of sediments as ballast material would be determined pre-construction following further geotechnical studies.

6.5.4.2.5 Type of scour protection for GBS

76. Scour protection may be necessary around the base of GBS to protect against currents and waves that may cause erosion of the sea bed. Scour protection could include, but is not limited to, rock armour, rock filled bags, pre-cast concrete block mattresses, tyre filled nets and rubber mats. The requirement for scour protection would be dependent on the particular GBS foundation and ground conditions at each foundation location.

77. If this foundation type is adopted, detailed work would be required to design suitable scour protection in the post-consent period. ***Table 6.7*** shows the maximum footprint per foundation, including and excluding scour protection required for foundations for GBS, this also equates to the worst case scenario for scour protection regardless of the foundation type used.

6.5.4.2.6 Decommissioning of GBS

78. The removal methodology for GBS would typically be as follows:

- Removal of wind turbine, met mast, switchgear and ancillaries, and cutting of cables (leaving buried inter-array cables *in-situ*);
- Mobilisation of heavy lift DP vessel or fleet of tugs (dependent on whether foundation design is buoyant or requires heavy lift);
- Removal of marine growth and sediment from base and jetting under base plate to remove adhesive effects of grout (if present) or cohesive bearing material. If a deep skirt has been used, the skirt may require cutting;
- It may also be necessary to locally remove scour protection via dredging;

- For buoyant design: controlled de-ballasting of foundation using remote pumping equipment and / or installation of buoyancy aids. Disposal of the ballasting material (i.e. whether it is disposed of locally or requires to be transported to a designated offshore disposal area) would be agreed with the regulators as part of the decommissioning plan.
- For design requiring heavy lift: lifting of foundation from sea bed onto barge (as per installation, a bespoke transportation barge may be required dependent on the design);
- For buoyant design: foundation would become buoyant on de-ballasting; and
- Transportation of foundation to port and dry dock (via towing or on barge dependent on foundation type) for deconstruction and reuse and recycling of materials where possible.

6.5.4.3 Suction Caisson and Jacket on Suction Caisson Foundation

79. Suction caissons may comprise a single steel cylindrical tower (the shaft) with a maximum diameter of 15m, a transition structure (the lid) and cylindrical skirt with a diameter of up to 35m, which penetrates into the sea bed.

80. Alternatively, a jacket foundation on suction caissons may be used. This would consist of a jacket, that would be installed on three or four suction caisson 'legs'. Each suction caisson would be up to 16m in diameter and spacing between caissons would be up to 64m.

81. Footprint sizes for the base are outlined in ***Table 6.9*** below.

Table 6.9 Suction Caisson and Jacket on Suction Caisson Foundation Dimensions

Wind turbine model	Maximum diameter (m)	Maximum Footprint (m^2)	Maximum footprint size with scour protection (m^2)
Suction caisson			
250m	31	755	3,020
300m	35	963	3,849
Jacket on suction caisson			
250m	14.5	3,081	9,801
300m	16	4,096	12,544

82. The base height of the skirt of the suction caisson above sea bed is typically 5m once penetrated, although it may be possible to install it below sea bed level to reduce scour effects. The skirt penetration would be up to 5m below the sea bed.

83. There are other foundation concepts comprising a cluster of smaller diameter suction piles, instead of a single larger diameter caisson. However, the overall maximum footprint and penetration is expected to be of a similar magnitude to that of either the single suction caisson or jacket on suction caisson options.

6.5.4.3.1 Material required for suction caisson foundations

84. Suction caisson foundations are usually comprised of mainly steel. However, it is possible that some secondary structures, such as handrails, gratings and ladders, could be produced using other metals, such as aluminium, or composites. Also, concrete could be used to form the working platform.

6.5.4.3.2 Sea bed preparation and penetration for suction caisson foundations

85. In areas where the sea bed is level, the suction caisson foundation may not require significant sea bed preparation. However, measures may be required in areas in which sand waves are present to provide a level formation for the installation and to allow scour protection to be later placed around the foundation. It is possible that excavation to the trough of the sand wave would be necessary before installing the suction caisson. If this foundation type is adopted, detailed work would be required pre-construction to determine preparation required for each foundation.

86. ***Table 6.10*** shows the seabed preparation scenarios for a 250m and a 300m wind turbine model with an assumed seabed preparation depth of 5m.

Table 6.10 Estimated Dimensions of Sea Bed Preparation for Suction Caisson and Jacket on Suction Caisson

Wind turbine model	Maximum area for seabed preparation per wind turbine (m^2)	Maximum volume of sediment removed per wind turbine (m^3)
Suction caisson		
250m	4,296	13,840
300m	4,688	15,250
Jacket on suction caisson		
250m	6,948	23,732
300m	8008	27,865

6.5.4.3.3 Installation method of suction caisson foundations

87. Suction caisson foundations are most likely to be towed to site by tugs as they are designed to be buoyant. There is also the possibility that foundations structures (particularly jacket structures) may be transported to site using a heavy lift vessel or barge. It would be expected that in the case of both suction caissons

or jacket on suction caissons, structures would be fully fabricated prior to transportation to site

88. The overall basic installation methodology would be expected to be as follows:

- Confirmation investigation of sea bed to ensure no obstructions are present (this would be on-going throughout the installation process);
- Prepare sea bed (if necessary) prior to installation;
- Suction caisson or jacket on suction caisson foundation transported to site;
- Suction caisson or jacket on suction caisson foundation is ballasted and lowered to sea bed;
- Initial penetration occurs under foundation self-weight;
- Pumps are attached to caisson and water evacuated. Typically, there are a number of chambers within the caisson in order to implement a controlled installation and to control levels. Water jetting may be used at the tip of the skirt to facilitate penetration;
- Install scour protection (likely to be rock dumping); and
- Spoil removal and disposal for suction caisson foundations.

89. Depending on the design of the foundations, ground conditions and requirement for scour protection, ground preparation works and scour protection installation maybe done pre or post foundation installation, or phased.

6.5.4.3.4 Spoil removal and disposal for suction caisson foundations

90. For suction caisson and for jacket on suction caisson foundations, sea bed preparation would be required and is dependent on the nature of the ground conditions present underneath the structures (for example, if sand waves are present). ***Table 6.10*** provides estimates of the volume of seabed which may require removal during sea bed preparation activities.

6.5.4.3.5 Type of scour protection for suction caisson foundations

91. Scour protection would be provided around the installed suction caisson. The requirements would be similar to those listed for gravity base structures in ***section 6.5.4.2.5***. The quantities and extent of scour protection would be dependent on current speed, sediment type and the foundation details.

92. If either of these foundation types are adopted, detailed pre-construction work would be required to design the scour protection for each foundation. ***Table 6.9*** gives an indication of the increase in foundation footprint that would result in the implementation of scour protection.

6.5.4.3.6 Decommissioning of suction caisson and jacket on suction caisson foundations

93. The overall removal methodology for suction caisson and jacket on suction caisson foundations would typically be as follows and would be agreed with regulators in the decommissioning plan:

- Removal of wind turbine, met mast, switchgear and ancillaries, and cutting ends of cables (leaving buried inter-array cables *in-situ*);
- Mobilisation of service vessel with pumping equipment and Remotely Operated Vehicle (ROV), and mobilisation of tugs. It may also be necessary to mobilise a DP vessel with craneage to facilitate with the re-floating and subsequent manipulation of the foundation;
- Removal of sediment and marine growth from suction caisson lid, and jetting of pump connections on lid. It may also be necessary to locally remove scour protection via dredging;
- De-ballasting or adding of buoyancy aids to foundation as required by design;
- Connection of pumping equipment to suction caisson valves;
- Controlled pumping of water into caisson chambers. The caisson would rise from its installed position to the surface as the internal pressure overcomes the side wall friction. Some manipulation from craneage on a DP vessel may also be required; and
- Transport of foundation to port and dry dock for dismantling and reuse and recycling where possible.

6.5.4.4 Monopile Foundations

94. Monopile foundations are the most common wind turbine foundation type used to date. They comprise a cylindrical steel pile and a cylindrical steel transition piece. Conical transitions are sometimes used to reduce the diameter of the structure at the top of the foundation. Site specific analysis is required to assess the suitability of this foundation option for the proposed East Anglia ONE North project. Footprint sizes for the base are outlined in ***Table 6.11***.

Table 6.11 Monopile Dimensions

Wind turbine model	Maximum diameter (m)	Maximum footprint (m^2)	Maximum footprint size with scour protection (m^2)
250m	13	133	3,319
300m	15	177	4,418

95. Maximum foundation penetration depth would be 45m below the surface of the sea bed.

6.5.4.4.1 Material required for monopiles

96. Monopile foundations usually comprise mainly steel. However, it is possible that some secondary structures, such as handrails, gratings and ladders, could be produced using other metals, such as aluminium, or composites. Also, concrete could be used to form the working platform.

6.5.4.4.2 Sea bed preparation and penetration for monopiles

97. In areas where the sea bed is level, the monopile foundation may not require significant sea bed preparation. However, measures may be required in areas in which sand waves are present to provide a level formation for the installation and to allow scour protection to be placed around the foundation. If this foundation type is adopted, detailed work would be required pre-construction to determine preparation required for each foundation.

98. ***Table 6.12*** shows the seabed preparation scenarios for a single 250 and a 300m wind turbine model with an assumed seabed preparation depth of 5m.

Table 6.12 Estimated Dimensions of Sea Bed Preparation for Monopile

Wind turbine model	Maximum area for seabed preparation per wind turbine (m^2)	Maximum volume of sediment removed per wind turbine (m^3)
250m	2,730	8,485
300m	2,888	9,000

6.5.4.4.3 Installation method of monopiles

99. The installation of steel monopile foundations would typically consist of the following key stages:

- Confirmation investigation of sea bed to ensure no obstructions are present (this would be ongoing throughout the installation process);
- Prepare sea bed (if necessary) prior to installation; delivery of steel monopiles and transition pieces to site via barge or by installation vessel. It may also be possible to tow floated piles to site using tugs;
- Installation of scour protection;
- Mobilisation of jack-up rig (alternatively floating vessel) with heavy craneage at installation location. It may also be necessary to mobilise a support vessel;
- Monopile upended by crane to vertical position;
- Monopile lowered to sea bed;
- Locating of driving hammer onto top of pile using craneage, and monopile driven to required depth. Where ground conditions are difficult, it may also be necessary to carry out drilling using drilling equipment operated from the installation vessel before completing the driving; and

- Lifting of transition piece on to top of monopile using craneage from installation vessel, levelling of transition piece and grouting of connection.

100. It has been estimated that the hammer energy that would be needed to drive a maximum 15m diameter monopile into the substrate would be a maximum of 4,000kJ.

6.5.4.4.4 Spoil removal and disposal for monopiles

101. For monopile foundations sea bed preparation would be required and is dependent on the nature of the ground conditions present underneath the structures (for example, if sand waves are present). ***Table 6.12*** provides estimates of the volume of seabed which may require removal during sea bed preparation activities.

102. Drilling would generate some spoil material that would require removal and disposal. With a maximum drill penetration depth of 45m and a maximum pile diameter of 15m, each pile would potentially produce a volume of 7,953m^3 of drill arisings. In keeping with the dredged material, it is proposed the spoil would be disposed of within the East Anglia ONE North windfarm site (to be designated), adjacent to each location from where the material was derived, with the spoil subsequently winnowed away by the natural tide and wave driven processes.

6.5.4.4.5 Type of scour protection for monopiles

103. Dependent on the nature of the metocean conditions and final monopile design, it may be necessary to install scour protection around the base of the foundation. Scour protection could include, but is not limited to, rock armour, rock filled bags, pre-cast concrete block mattresses, tyre filled nets and rubber mats.

104. The quantities and extent of scour protection would be dependent on current speed, sediment type and the foundation details. Detailed pre-construction work would be required to design the scour protection for each foundation.

105. ***Table 6.11*** gives an indication of the increase in foundation footprint that would result from the use of scour protection.

6.5.4.4.6 Decommissioning of monopiles

106. The removal methodology for steel monopile foundations would typically be as follows:

- Removal of wind turbine, met mast, switchgear and ancillaries, and cutting ends of cables (leaving buried inter array cables *in situ*);
- Mobilisation of service vessel;
- Local jetting and / or suction around base of monopile to a depth of approximately 1 to 2m;

- Deployment of underwater remote abrasive cutting equipment from service vessel;
- Mobilisation of heavy lift DP vessel or jack-up rig and attachment of crane slings to top of monopile and transition piece;
- Abrasive cutting of monopile at a depth of approximately 1 to 2m below the sea bed;
- Lifting of combined monopile and transition piece by crane on DP vessel or jack-up rig onto barge; and
- Transportation of monopile and transition piece to port and dry dock for dismantling and reuse and recycling where possible.

107. It should be noted that it would not be intended to reinstate the local excavations remaining at the monopile locations as it is anticipated that this would refill naturally over time.

6.5.5 Aviation and Navigational Marking

108. The wind farm would be designed and constructed to satisfy the requirements of the Civil Aviation Authority (CAA) and the Trinity House Lighthouse Service (THLS) in respect of marking, lighting and fog-horn specifications. CAA guidelines as outlined in "CAA Policy and Guidelines on Wind Turbines" (February 2016) would be adhered to. THLS recommendations would be followed as described in "Provision and Maintenance of Local Aids to Navigation Marking Offshore Renewable Energy Installations" and "the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) Recommendation 0-139 on the Marking of Man-Made Offshore Structures", (IALA 2013).

109. The colour scheme for nacelles, blades and towers is typically RAL 7035 (light grey). Foundation steelwork is generally in RAL 1023 (traffic light yellow) up to the Highest Astronomical Tide (HAT) +15m or to Aids to Navigations, whichever is the highest.

110. Lighting requirements would follow the MCA (2018) guidance, Offshore Renewable Energy Installations: Requirements, Guidance and Operational Considerations for Search and Rescue and Emergency Response. This will ensure that adequate consideration with regard to lighting of offshore structures is given for Search and Rescue and Emergency Response. In addition, the following assumptions have been made with regards to lighting of the East Anglia ONE North windfarm site:

- Red, medium intensity aviation warning lights (2000 candela (cd)) will be located on either side of the nacelle of significant peripheral wind turbines.

These lights will flash simultaneously with a Morse W flash pattern and will also include an infra-red component;

- All aviation warning lights will flash synchronously throughout the East Anglia ONE North windfarm site and be able to be switched on and off by means of twilight switches;
- Aviation warning lights will allow for reduction in lighting intensity at and below the horizon when visibility from every wind turbine is more than 5km;
- Search and rescue (SAR) lighting of each of the non-periphery turbines will be combi infra-red (IR)/200cd steady red aviation hazard lights, individually switchable from the control centre at the request of the MCA (i.e. when conducting SAR operations in or around the East Anglia ONE North offshore windfarm site);
- All wind turbines will be fitted with a low intensity light for the purpose of helicopter winching (green hoist lamp). All wind turbines will also be fitted with suitable illumination (minimum one 5cd light) for ID signs; and
- Marine navigational lights will be fitted at the platform level on significant peripheral structures (SPS). These lights will be synchronized to display simultaneously an IALA “special mark” characteristic, flashing yellow, with a range of not less than five (5) nautical miles.

6.5.6 Meteorological Masts

111. There is the potential for one meteorological mast (met mast) to be installed within the East Anglia ONE North windfarm site. The maximum height of this met mast would be 200m (LAT).

112. The foundations used may be jacket (with pin piles or suction caissons), gravity base structure, suction caisson or monopile. ***Table 6.13*** addresses the different foundation options required to support the met mast and its associated footprint, with and without scour protection.

Table 6.13 Indicative Met Mast Foundation Footprint

Foundation Type	Maximum Footprint (m^2)	Maximum Footprint with Scour Protection (m^2)
Jacket with pin piles	400	900
Jacket with suction caissons	651	2,451
Gravity base	177	707
Suction caisson	315	2,828
Monopile	51	1,257

6.5.7 Buoys

113. It is anticipated that up to 20 buoys would be required across the East Anglia ONE North windfarm site, these would be LiDAR, wave or guard buoys. Each buoy would be up to four metres wide and six metres high and would include a lantern suitable for use as a navigational aid.

114. These devices would be attached to the sea bed using mooring devices such as common sinkers (small block of heavy material such as concrete, steel, etc.) or anchored by means of regular anchors. They could have one single mooring point or several points (usually up to three), with an anticipated total footprint of $4m^2$.

6.5.8 Ancillary Works

115. Ancillary structures are likely to form part of the final design of the windfarm; however, the requirement and nature of these would be determined at the detailed design phase. Ancillary structures may include: temporary landing places, moorings or other means of accommodating vessels in the construction and / or maintenance of the authorised development; buoys (in addition to those outlined in ***section 6.5.7***), beacons, fenders and other navigational warning or ship impact protection works; and temporary works for the benefit or protection of land or structures affected by the authorised development.

6.5.9 Offshore Electrical Platforms

116. The proposed East Anglia ONE North project will require a minimum of one up to a maximum of four offshore electrical platforms, which will contain electrical equipment to aggregate the power from the wind turbines and convert it into a more suitable form for export to shore.

117. The offshore electrical platforms will be located within the East Anglia ONE North windfarm site and the precise location(s) will be determined during detailed design work conducted pre-construction.

6.5.9.1 Offshore Electrical Platforms

118. The offshore electrical platforms would accommodate the transformers required to increase the distribution voltage (66 to 75kV) of the inter array cables to a higher export voltage of typically 110 to 400kV.

119. The topside structure would be configured in a multiple deck arrangement at each offshore electrical platform. Decks would either be open with modular equipment or the structure may be fully clad. All weather sensitive equipment would be placed in environmentally controlled areas. ***Plate 6.7*** shows a typical offshore electrical platform.

Plate 6.7 Typical offshore electrical platform (AC collector station) (photo taken from the East Anglia ONE project)

120. The dimensions of the offshore electrical platforms would depend on the capacity and number of platforms constructed. However, the offshore electrical platforms will have a maximum topside width of 50m, maximum topside length of 70m and a maximum topside height of 50m (above LAT).

6.5.9.2 Offshore Electrical Platform Foundation Type

121. The offshore electrical platforms would require bespoke foundations on which to place the topsides. The types of foundation under consideration include steel jacket (with pin piles (up to 4.6m diameter) or suction caisson) or possibly a gravity based structure. The offshore electrical platform foundations would be greater in size than the wind turbine foundations due to the size and weight of the topsides. Estimates for the maximum footprints for offshore electrical platforms are presented in ***Table 6.14***.

Table 6.14 Indicative Offshore Electrical Platform Foundation Footprints

Foundation Type	Maximum Footprint (m^2)	Maximum Scour Protection Area (per platform) (m^2)
Jacket with pin piles	4,074	5,331

Foundation Type	Maximum Footprint (m^2)	Maximum Scour Protection Area (per platform) (m^2)
Jacket with suction caissons	5,676	15,276
Gravity base	4,800	12,000

122. An alternative option is a self-installing structure, which is towed to site and then lowers legs, jacks-up to an appropriate clearance above water before being fixed *in-situ*, probably using pin piles as would be used for a jacket foundation.

123. The installation of the offshore electrical platform support structures would be as described in ***section 6.4*** relating to wind turbine foundation units (apart from the self-installing system summarised above).

124. The topsides may be installed via the following methods:

- By a suitable crane vessel (or vessels working together) in a single lift;
- By a suitable crane vessel (or vessels working together) in separate lifts of deck and sub-modules;
- Using a rail-skid transfer from a large jack-up; and
- Self-installing.

6.5.10 Offshore Construction, Operation and Maintenance Platform

125. A single construction O&M platform may be required to house construction and operation and maintenance personnel and equipment. This would require a foundation structure likely to be similar to that of the offshore electrical platforms (***section 6.4***) and would have the same footprint as outlined in ***Table 6.14****.*

126. The construction, operation and maintenance platform would have a topside up to 50m wide by 70m long and with a topside height of 50m (above LAT).

6.5.11 Electrical Infrastructure

127. The proposed East Anglia ONE North project will use a High Voltage Alternating Current (HVAC) electrical system. HVDC is not being considered.

6.5.11.1 Export Cables: Cable routes

128. Offshore export cables will be laid between the offshore electrical platform(s) and the landfall location. The East Anglia ONE North offshore cable corridor is shown in ***Figure 6.1****.* There would be up to two export cables installed. Each cable would have a maximum length of 76km resulting in a maximum combined length of 152km.

6.5.11.2 Export Cables: Pre-lay Works

129. The East Anglia ONE North windfarm site would be connected to landfall by up to two offshore export cables, where they will join up to six cables, via a transition pit, that will connect to the onshore substation. The offshore cables themselves each have a diameter of approximately 120 to 300mm and each consist of one copper or aluminium conductor with electrical insulation material, screens, communication fibre and protective armour layers. Each export cable would have one fibre optic cable either integrated within the cable itself or secured to the outside.

130. In areas with large ripples and sand waves, the sea bed may first require levelling (subject to detailed studies) by dredging before the cable could be installed.

131. Before cable-laying operations commence, it would be necessary to ensure that the offshore cable corridor is free from obstructions such as discarded trawling gear and abandoned cables identified as part of the pre-construction survey. A survey vessel would be used to clear all such identified debris, in a pre-lay grapnel run (PLGR).

132. The offshore export cable would be routed as far as possible in soft sediments to allow it to be buried into the sea bed. In the event that boulders or debris are encountered on the sea bed, they should be removed before the cable is laid. If the grapnel tool cannot remove all obstructions completely, some hydraulic removal works or ploughing may take place. No blasting is planned to take place in the offshore cable corridor to remove bedrock.

133. If the offshore cable corridor crosses an out of service cable it may be recovered from the sea bed before laying the offshore export cable. The removal would be dependent on depth of burial, accessibility and agreement with the cable owners that the cable or sections of it can be removed or crossed. Subject to detailed pre-construction surveys, it is estimated that up to four crossings of the export cable with out of service cables (see ***Figure 17.2*** in ***Chapter 17 Infrastructure and Other Users***) may be required.

134. Crossings preparation would be informed by the aforementioned surveys to locate the asset and determine actual depth of burial. Following this, placement of protection would need to be carried out.

6.5.11.3 Export Cables: Installation and burial method ploughing, trenching, jetting, depth of burial (offshore)

135. The preferred construction technique and depth of burial for the offshore electrical infrastructure would be decided after the pre-construction geotechnical ground investigation, a risk assessment and a lifetime maintenance assessment. Each

of the possible installation techniques (ploughing, jetting and trenching) have constraints within which they can be effectively utilised, e.g. shallow water, depth of burial required, sediment disturbance, sediment type and minimum bend radius. The offshore export cables would be buried at a depth between 0.5m and 5m for the majority of the route.

136. The installation practices can be divided into the following classes:

- Cables are surface laid by a laying vessel, and burial is carried out in a post-lay mode using a separate vessel and trenching / jetting equipment spread depending on the method; or
- Cables are laid and buried in a simultaneous operation with burial equipment being towed by the cable laying vessel or barge, in the case of plough or burial sled, or operated from laying vessel where a self-propelled ROV is utilised.

6.5.11.3.1 Burial methods: Ploughing

137. Ploughing has been specified for major HVAC systems in the past and this generally produces better burial results than post lay burial in some ground conditions.

138. A forward blade cuts through the sea bed laying the cable behind. Ploughing tools could be pulled directly by a surface vessel or could be mounted onto self-propelled caterpillar tracked vehicles which run along the sea bed taking power from a surface vessel. The plough inserts the cable as it passes through the ground.

139. Even if the primary method adopted for laying the export cables is ploughing there would still likely be local spots that would require jetting or other methods to bury and protect the cable e.g. for any jointing loops and where ploughing would be unable to negotiate obstacles, cable crossings, etc.

6.5.11.3.2Burial methods: Jetting

140. This method involves the use of a positioned cable vessel and a hydraulically powered water jetting device that simultaneously lays and embeds the cables in one continuous trench. The equipment uses pressurised water from a water pump system on board the cable vessel to fluidize sediment.

141. There are two methods of water jetting which are:

- Laying the cable first and jetting at a later time - The cable is laid on the sea bed first and afterwards a jetting sledge is positioned above the cable. Jets on the sledge flush water beneath the cable fluidising the sand whereby the cable, by its own weight, sinks to the depth set by the operator. As the sediment is fluidised a minor amount of sediment spill is expected.

- Laying the cable and jetting at the same time - In this method water jets are used to jet out a trench and the cable is laid into the trench behind the jetting lance. As with previous method, as the sediment is fluidised a minor amount of sediment spill is expected.

142. Jetting tools can be pulled directly by a surface vessel or can be mounted onto self-propelled caterpillar tracked vehicles which run along the sea bed taking its power from a surface vessel.

6.5.11.3.3 Burial methods: Vertical injector

143. In shallow waters, a vertical injector could be used. This is a large jetting and cutting share which is strapped to the side of a barge and the cable is laid in the foot of the trench. This technique can provide deeper than traditional method burial which can be utilised through areas of high sea bed mobility or whilst crossing areas of high risk.

144. The burial depth is controlled by means of raising or lowering the tool and horizontal positioning, by means of adjusting the barge anchors.

6.5.11.3.4Burial methods: Trenching or cutting

145. Trenching or cutting would be used where other methods for protecting the cable are not economically and / or technically feasible. One such area where trenching is likely to be required is in the nearshore area where a limited amount of trenching may be required at the HDD punch-out location.

146. This method generally 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.

6.5.11.4 Cable Laying and Burial Speeds

147. The speed of cable laying would differ between vessel types. The speed of cable laying (for all installation methods and vessel types) will depend on the ground conditions, sea bed profile and water depth. Indicative installation rates are shown in ***Table 6.15***.

Table 6.15 Typical Cable Installation Rates for Different Burial Methods

Method	Speed (m/hour)
Ploughing (single cable)	300
Jetting	300

Method	Speed (m/hour)
Trenching	30 - 80
Vertical injector (shallow water only)	30 - 80

6.5.11.5 Cable Protection

148. In some cases, such as unsuitable sea bed conditions or where another cable or pipe is already in place, the above methods cannot be applied and it is necessary to use alternative methods for installing the cable. Details of some of the techniques employed are given below:

- **Rock placement** - involves the laying of rocks on top of the cable to provide protection which is effective on crossings or areas where unsuitable sea bed conditions are encountered. This can be used where long sections of cable require protection.
- **Concrete mattresses** - are prefabricated flexible concrete coverings that are laid on top of the cable, as an alternative to rock placement. The placement of mattresses is slow and as such is only be used for short sections of cable protection. Grout or sand bags, are used similarly to concrete mattressing with mattresses filled with grout and / or sand used in place of the prefabricated concrete mattresses, this method is generally applied on smaller scale applications than concrete mattressing.
- **Frond mattresses** could be used to provide protection by stimulating the settlement of sediment over the cable. This method develops a sand wave over time protecting the cable but is only suitable in certain water conditions. This method may be used near offshore structures though experience has shown that storms can strip deposited materials from the frond.
- **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. Uraduct does not provide protection from damage due to fishing trawls or anchor drags.

149. The total estimates for cable protection in the East Anglia ONE North windfarm site and offshore cable corridor are presented in ***Table 6.16***.

Table 6.16 Cable Protection Requirements for the East Anglia ONE North offshore development area

Cable Type and Location	Total Area (m^2)	Total Volume (m^3)
Cable protection for platform link cables (see ***section 6.5.11.14***)	104,550*	121,800

Cable Type and Location	Total Area (m^2)	Total Volume (m^3)
Cable protection for the inter-array (see ***section 6.5.11.14***)	210,800*	99,200
Cable protection for export cable (see ***section 6.5.11.5***)	175,440*	80,000

**Includes cable crossings and assumes 10% of export cable route and windfarm site will be unsuitable for burial.*

6.5.11.6 Export Cables: Electro-Magnetic Fields and heat generated

150. The offshore export cables transmit the electricity from the offshore electrical platform(s) to the designated onshore landfall point at a higher voltage (known as the transmission or export voltage) than is used for the inter array cables.

151. Electro Magnetic Fields (EMF) emitted by HVAC three cores offshore subsea cable is minimised by the arrangement of the cable cores: the three cores are laid together in trefoil and as the phase currents are balanced, the magnetic fields of the three cores tend to zero. For that, the magnitude of the magnetic fields in the proximity of the cable is null and its presence in the sea bottom inert. Burial of the cable will also act to minimise emission of EMF.

152. Heat loss per metre for a typical 1,000mm^2 offshore HVAC 132kV 3-core cable is 30W/m.

6.5.11.7 Export Cables: Minimum cable spacing, number and width of cable trenches

153. The minimum separation of the export cables is determined primarily to reduce the risk involved of damaging a pre-laid cable during installation due to the inherent difficulty of ensuring that the cable burying plough is in the precise position. In addition, following installation of the export cables, should any cable be required to be retrieved for maintenance, the separation distance allows confidence to recover a cable without disturbing others and to re-install a repaired cable on the sea bed without damaging the adjacent cable. The space required to install a repaired cable would depend on the water depth at the fault location. The primary factor that would influence this spacing and the burial depth would be the geology of the sea bed along the route with additional influences such as sea bed obstacles including wrecks and other sub-sea cables or pipelines.

154. A practical offshore cable corridor width needs to allow for:

- Sufficient space to allow crossing of existing cables and pipelines as close as possible to a 90-degree angle;
- Sufficient space that the offshore export cable route that does not inhibit the operation and maintenance activities of existing cable and pipelines;

- Sufficient width for installation vessels to manoeuvre and anchor;
- Sufficient width to allow for any maintenance activities, including space to effect cable recovery and repairs;
- To incorporate sea bed lease requirements from The Crown Estate; and
- To incorporate best practice guidelines (as far possible) from latest DNV-KEMA guidelines.

155. When two export cables are installed there needs to be sufficient space between them to:

- Minimise the risk of plough (or other burial tool) over-run;
- Allow barges in shallow water to dry out without settling on top of the cable;
- Allow for installation vessels to manoeuvre during installation where there are bends in the offshore cable corridor; and
- Allow the repair bight to be laid out where repairs are needed.

156. This spacing is assumed to be between 50m and 255m to allow for the above scenarios; however, this will be refined following a detailed cable burial assessment, prior to construction for the proposed East Anglia ONE North project. If the sea bed is extremely soft in nature, this spacing may be widened to ensure a safe placement of anchors.

157. Additionally, a minimum of 250m is required between export cables and the boundary of the cable corridor to act as a buffer to protect the installed cables.

6.5.11.8 Export Cables: Disturbance and displacement

158. It has been estimated that the export cable installation process could result in a maximum cable installation width of up to 20m per cable, in order to achieve a maximum 5m deep burial of cables.

159. There would be material displaced by the presence of the cable, however this would be minimised as any resulting plough trench would be backfilled with its own material through natural processes.

160. Some material may be displaced before cable-laying if rocks need to be moved from the offshore cable corridor or if the sea bed needs to be levelled by dredging in areas with high and steep sand waves. Where sand waves that require to be levelled are encountered, the profile of levelling works along the export cables would be 60m wide, with an average depth of 2.5m and a slope gradient of 1:4. The sediment released at any one time would be subject to the capacity of the dredger and any required sand wave levelling would be in discrete areas and not along the full length of the corridor.

161. ***Table 6.17*** outlines the anticipated disturbance areas and volumes from the installation of export cables. It should be noted that the area of disturbance caused during export cable installation would be encompassed by the PLGR. A conservative maximum width of seabed disturbance along the PLGR of 20m has been assumed to account for potential future increases in cable laying plough and pre-lay grapnel run requirements. For example, the width of the export cable installation plough being used on East Anglia ONE is 5.5m wide, however, these may increase in the future.

Table 6.17 Anticipated Maximum Disturbance Areas and Volumes from Installation of the East Anglia ONE North Offshore Export Cables

Activity	Maximum Area Affected (m^2)	Maximum Volume Affected (m^3)
Export cable installation	3,040,000	N/A[1]
Sand wave levelling / pre-sweeping	800,000	500,000
Trenching in the HDD pop-out location	This is incorporated within the areas affected for export cable installation and sand wave levelling.	800,000

6.5.11.9 Export Cables: Jointing infrastructure

162. The jointing of export cables offshore would require a significant weather window. Typically; the jointing can take between one and ten days after both cable ends are secured on-board the jointing vessel. Additional time is needed to recover the cables pre-jointing and rebury the cable post-jointing.

6.5.11.10 Export Cables: Cable Crossing

163. There are several existing cables within the offshore cable corridor (see ***Table 6.18*** and ***Chapter 17 Infrastructure and Other Users*** for details). Each crossing will require a cable crossing agreement signed between the owners.

Table 6.18 Summary of Offshore Cables and Pipelines Which Intersect the Offshore Cable Corridor

Asset Name	Asset Type	Operator	General Trajectory (approximate)
Concerto 1 North	Telecommunications cable (operational)	Interoute	East to West

[1] The installation of subsea cables has the potential to disturb the sea bed down to a depth of up to 5m. It is difficult to estimate the actual volumes of sediment (and subsequent suspended sediment levels) that would be affected during installation of cables however the types and magnitudes of effects that could be caused have previously been assessed within an industry best-practice document on cabling techniques (BERR 2008). This document has been used alongside expert judgement and analysis of site conditions to inform the relevant technical assessments.

Asset Name	Asset Type	Operator	General Trajectory (approximate)
Concerto 1 South	Telecommunications cable (operational)	Interoute	West to East
Atlantic Crossing 1	Telecommunications cable (out of service)	Global Crossing	West to East
Greater Gabbard export cable route	Three transmission cables (operational)	Greater Gabbard OFTO Plc	North to South
Galloper export cable route	Two transmission cables (operational)	Galloper Wind Farm Limited	North to South
Bacton Zeebrugge	Gas pipeline (operational)	Caisse; Snam and Fluxys	North west to South East

164. Where the offshore export cable is required to cross an obstacle such as a communications cable, protection is required to protect the cable being crossed. Once protection is in place it would not be possible to bury the cable being laid, leaving it more susceptible to external damage. Therefore, protection is required over the second cable.

165. It is anticipated that, where the East Anglia ONE North export cables would cross existing cables, concrete mattressing, fronded mattressing, rock dumping, bridging or gravel bags would be used for protection. The total maximum height of a cable crossing is predicted to be 2.25m, with a width of 8.5m and length of 160m. In shallow waters, the height of cable crossings may be required to be reduced to avoid impingement of water depth for navigation.

166. For a typical cable crossing using a concrete mattress, typical dimensions of each mattress would be 6m long by 3m wide by 0.3m high. The number of mattresses required would depend on the size, type and vertical position of the asset to be crossed, the number of cables crossed and the separation of the cables that can be achieved at the point of the crossing. An alternative may be a bespoke designed concrete bridge which is installed over the existing cable with the offshore export cable being installed perpendicular, over the bridge. A substitute to concrete mattresses may involve rock filter bags laid over the existing obstacle. The anticipated maximum footprint of cable protection material due to crossings within the East Anglia ONE North offshore cable corridor would be 46,240m^2 with a maximum height of 2.25m.

167. Other factors that need to be taken into account when considering an offshore crossing are:

- Avoid existing offshore cable joint locations (100m boundary) as these sites are more prone to failure and as such there exists a greater possibility for a requirement to recover the cable in the future.
- Avoid existing crossings of cables and pipelines to prevent triple crossings which increase risk and difficulty of recovery should any of the elements require repair.

168. In addition, the presence of sand waves can result in scouring of the cable or the cable being laid in suspension over time. To prevent this, the cable would ideally be placed in the troughs of sand waves, if this is not possible; an alternative would be to dredge the top of the sand waves.

169. There will be a maximum of 34 crossings required along the export cable route. An indicative figure showing potential cable and pipeline crossing locations along the export cable route is presented in ***Figure 6.3*** and ***Chapter 17 Infrastructure and Other Users***.

6.5.11.11Inter-array and Platform Link Cables: Indicative electrical layout

170. Inter-array cabling within the East Anglia ONE North windfarm site would be a maximum of 200km in combined length, depending on the final layout of the wind turbines. Platform link cables (i.e. cables which transmit electricity between offshore platforms) would be a maximum of 75km in combined length. Wind turbines are normally installed in arrays or 'strings' where a series of turbines are connected to each other, with the first turbine in the 'string' connected to the offshore electrical platform. The electrical layout would be designed to minimise length of cable, number of cables and electrical losses.

6.5.11.12Inter-array and Platform Link Cables: Cable type, diameter, insulation, armour EMF/heat generated

171. The inter-array cables connect the wind turbines into strings and then connect the strings to the offshore electrical platform(s). Platform link cables connect offshore platforms. Each platform link cable between offshore electrical platforms may be up to 15km in length. The components of an inter-array cable are presented in (***Plate 6.8***).

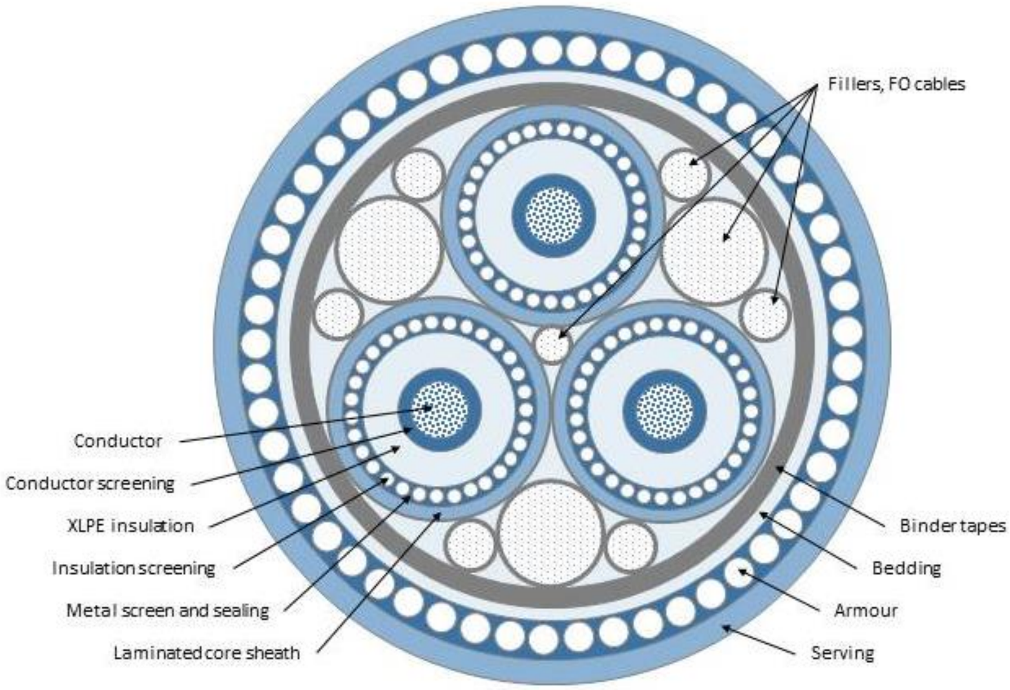


Plate 6.8 Inter-array Cables

172. The AC inter-array and platform link cables would typically be rated at 66 to 110kV with 3-core copper conductors, insulation and conductor screening and steel wire armour. All cables would contain fibre optics either embedded between the cores or strapped to the outside, for communication purposes.

173. EMF would be minimised due to the balanced and screened three-core system.

174. Heat loss per meter for a typical 800mm^2 offshore HVAC 66kV 3-core cable is 40W/m.

6.5.11.13Inter-array and Platform Link Cables: Installation and burial method

175. For smaller cable sizes, it is possible to use barges to lay the cable and these are generally at multiple short lengths.

176. The cables would be supplied on drums, cages or carousels on board a cable vessel or barge.

177. Each section of cable is laid from the cable lay vessel either from a static coil or a revolving turn carousel, turntable or drum depending upon the characteristics of the cable. The cable is led via a cable pick-up arrangement and an associated cable trackway through linear cable engines and is led over board through a cable chute or stinger usually mounted at the stern of the vessel.

178. The cable would be pulled into the foundation via a J-tube (or alternative cable entry system), and later connected to the wind turbine. The rest of the cable would be laid along the sea bed and at the next wind turbine the cable would be again pulled into the foundation and later connected to the wind turbine.

179. Due to the water depths, it is not planned to use divers for any installation work. ROVs will be used when needed.

180. The inter-array and platform link cables would be installed using a mix of the following methods. See ***section 6.5.11.3*** for details of these methods:

- Ploughing;
- Pre-trenching or cutting; and
- Jetting.

181. The anticipated maximum areas affected during the installation of inter-array and platform link cables are set out in ***Table 6.19***.

Table 6.19 Anticipated Maximum Disturbance Areas and Volumes from Installation of the East Anglia ONE North Inter-array and Platform Link Cables

Cable Type	Maximum Area Affected (m^2)	Maximum Volume Affected (m^3)
Inter-array	4,000,000	N/A[1]
Platform link	1,500,000	N/A[1]

6.5.11.14 Inter-array and Platform Link Cable Protection

182. In some cases, the above methods cannot be applied and it is necessary to use alternative methods other than burial (for details see ***section 6.5.11.5***):

- Rock placement;
- Concrete mattresses;
- Frond mattresses; or
- Uraduct.

6.5.11.15 Inter-array and Platform Link Cable Protection: Cable crossings

183. It has been anticipated that there will be up to 49 crossings required for platform link cables and up to 30 crossings for inter-array cables within the East Anglia ONE North windfarm site. The cables which intersect the East Anglia ONE North windfarm site are shown in ***Table 6.20***, for further details also see ***Chapter 17 Infrastructure and Other Users***.

Table 6.20 Summary of Offshore Cables Which Intersect the East Anglia ONE North Windfarm Site

Asset Name	Asset Type	Operator	General Trajectory (approximate)
Ulyssess 2	Telecommunications cable (operational)	Verizon Business	West to East

184. Where cable crossings occur, they will be protected using the methods as used for cable protection when cable burial is not possible (as described in ***section 6.5.11.5***). The anticipated maximum footprint of cable protection material due to crossings within the East Anglia ONE North windfarm site would be 81,600m^2 with a maximum height of 2.25m.

6.5.11.16Inter-array Cables: Hook Up Methods to Wind Turbines

185. It is planned not to use divers for cable installation. The hook up would be done by the support of ROV vehicles.

6.5.11.17Inter-array and Platform Link Cables: Spacing

186. Where buried using a plough, each section of inter-array or platform link cable would be laid separately.

187. When approaching the offshore electrical platforms or wind turbine foundations, several cables may converge and the distance between cables would be reduced.

188. Methods for crossing other cables, pipelines etc. are the same as per export cables and are listed in ***section 6.5.11.10***.

6.5.12 Construction Vessels, Helicopters and Logistics

189. The number and specification of vessels employed during the construction of the proposed East Anglia ONE North project would be determined by the marine contractor and the construction strategy following successful consent to construct the project. It is anticipated that several types of construction vessel could work in parallel during the construction of the offshore windfarm.

190. The final selection of the port facilities required to construct and operate the proposed East Anglia ONE North project has not yet been determined.

191. Indicative vessel types required during the construction and operation stages are shown in ***Table 6.21***.

Table 6.21 Indicative Vessel Requirements at Construction and Operation Stages

Activity	Vessel Type	Indicative Number
Foundation installation	Dredging vessel	4

Activity	Vessel Type	Indicative Number
	Tugs and barges storage and transport	10
	Jack-up vessel	2
	Dynamic position heavily lift vessel	3
	Support vessel	5
Wind turbine installation	Jack-up vessel	3
	Dynamic Position Heavy Lift Vessel	1
	Windfarm service vessel	2
	Support vessels	2
Platform installation	Installation vessel	2
	Tug with accommodation barge	2
	Supply vessel	2
	Support vessels	3
Cable installation	Inter-array cable laying vessel	3
	Export cable laying vessel	2
	Export cable support vessel	3
	Pre-trenching/backfilling vessel	3
	Cable jetting and survey vessel	3
Other Vessels	Workboat	15
	Accommodation and supply vessel	2

192. It is anticipated that approximately 74 vessels would be on site at any one time during the construction of the proposed East Anglia ONE North project. Numbers of vessels will be confirmed with further input from construction contractors post-consent.

193. It is estimated that approximately 3,335 individual vessels trips would be required during the construction of the proposed East Anglia ONE North project. It is estimated that the installation of each wind turbine foundation will require up to three vessel movements of the installation vessel.

194. There may also be a requirement for helicopters to travel to and from the East Anglia ONE North windfarm site to assist with construction activities. It is

estimated that approximately 981 helicopter round trips may be required during the offshore construction period.

6.5.12.1 Anticipated Safety Zones

195. Some restrictions on vessel movements within the offshore development area will be required to protect the health and safety of all users of the sea. It is anticipated that vessels would navigate to give each windfarm asset as large a clearance as possible. However, to reduce the possibility of vessel collisions, it may be considered necessary to apply for rolling safety zones.

196. The powers to make safety zones are set out in Section 95 of the Energy Act 2004, and are related to renewable energy installations, encompassing wind turbines, electrical platforms and meteorological masts. Safety zones for inter-array, or export cables are not covered within the Energy Act 2004.

197. The safety zones that could be applied for as part the East Anglia ONE North DCO submission are presented in ***Table 6.22*** below.

Table 6.22 Potential Rolling Safety Zones during Construction, Operation and Decommissioning

Type of Safety Zone	Area Covered
Construction[1]	Up to 500m around each foundation or renewable energy installation whilst under construction
Commissioning[2]	Up to 50m around each renewable energy installation where construction has finished but some work is ongoing, e.g. wind turbine incomplete or in the process of being tested before commissioning.
Major Maintenance[2]	Up to 500m when major maintenance is in progress (use of jack-up vessel or similar).
Decommissioning	Up to 500m at the end of the working life of a renewable energy installation when it is being removed from site
[1] *The Construction, Major Maintenance and Decommissioning rolling safety zones are required to ensure a safe distance is maintained from vessels engaged in high risk activities such as jacking operations and heavy lifts.*	
[2] *The Commissioning safety zones are required to ensure small vessels are not adversely affected by propeller or thruster wash from vessels used for transfer whilst also ensuring no additional risk is created for personnel during access and egress. This zone also reduces risk of injury to third parties from items dropped from aloft.*	

198. Whilst no formal application of a safety zone around cable laying operations is possible under Section 95 of the Energy Act 2004, it is the intention to propose rolling Advisory Exclusion Zones of up to 500m around vessels installing export cables, platform link cables and inter-array cables in the interests of the safety of

all users of the sea, and to provide clearance of 500m from laid cables until burial is confirmed in case of interaction with anchors or fishing gear.

6.5.12.2 Vessel Profiles

199. This section provides an overview of the types of vessel that would be used in the construction, operation and decommissioning of the proposed East Anglia ONE North project.

200. **Jack-up vessels:** Jack-up vessels are considered an option for the installation of jacket foundations and wind turbines along with floating vessels.

201. Floating vessels are under consideration for some operations although the techniques are not always proven so jack-up vessels are still likely to be used. Jack-up vessels would result in a maximum seabed footprint of 3,000m^2.

202. **Dynamic positioning (DP) heavy lift vessel:** If used for the proposed East Anglia ONE North project, a heavy lift vessel would need to be capable of lifting heavy loads such as transition pieces and nacelles into place.

203. DP is a computer-controlled system which is used to automatically maintain a vessel's position and heading by using its own propellers and thrusters. Position reference sensors, combined with wind sensors, motion sensors and gyro compasses, provide information to the computer pertaining to the vessel's position and the magnitude and direction of environmental forces affecting its position.

204. DP vessels often make use of azimuth thrusters whereby the propeller is placed within a pod or a duct to allow rapid repositioning of the thruster in response to changes in vessels position. This enables the vessel to stay in a precise location.

205. **Accommodation vessel:** One or more accommodation vessels could be used as a temporary home to the workers who install and commission the wind turbines and electrical infrastructure at the windfarm. These types of vessels are sometimes known as “flotels”.

206. **Windfarm service vessel:** Windfarm service vessels are typically much smaller than the jack-up, heavy lift and accommodations vessels and are usually no greater than 30m in length. These vessels are often multi-hulled which makes them more stable and moveable especially in rough sea conditions.

207. Service vessels would vary in design and dimensions as they would be required to carry out a variety of different services and operations.

208. **Cable laying vessel:** There may be up to two separate vessels involved in laying the inter-array and export cables. In one scenario, the first vessel would lay the

cable on the sea bed and the second would bury the cable. Alternatively, one vessel would lay and bury the cable at the same time.

209. Cable laying vessels are typically very large (70m or more) with lots of laydown area to accommodate the hundreds of kilometres of cable needed on an offshore wind farm.

6.5.13 Oils, Fluids and Effluents

210. Oils in the wind turbines shall be biodegradable where possible. All wind turbines would have provision to retain all spilled fluids within nacelle or tower. The volume of oil and fluids would vary depending on wind turbine design, i.e. whether conventional design or gearless or whether one or two rotor bearings are used in the design. It may also depend on the amount of redundancy designed into the system.

211. All chemicals used would be certified to the relevant standard. A brief summary of oils and fluids in the systems is given in ***Table 6.23***.

Table 6.23 Example of Volumes of Oils and Fluids in a Typical Wind Turbine

Component	Volume (L)	Comment
Gearbox	Up to 100	Mobilgear SHC XMP 320 or equivalent
Hydraulic pitch (if used)	500	ISO 32 biodegradable hydraulic fluid
Coolant systems	Approximately 1000	50% Glycol or water
Transformer	Up to 1,500	Biodegradable ester-based oil
Yaw and motors	Not determined	Soap based lithium grease

212. Examples of substances contained in the offshore electrical platforms are as follows:

- Diesel for the emergency diesel generators (in diesel storage tanks);
- Oil for the transformers;
- Deionised water for the valves cooling system;
- Glycol;
- Sewage and grey water;
- Lead acid in batteries;
- Engine oil; and
- SF6 (gas coolant).

213. To avoid discharge of oils to the environment the wind turbines and offshore electrical platforms are anticipated to be subject to best-practice design, for example with a self-contained bund to collect any possible oil spill. To avoid discharge or spillage of oils it is anticipated that the transformers would be filled for their life and would not need interim oil changes.

6.5.14 Disposal Sites

214. It should be noted that for all foundation types and cable installation activities within the East Anglia ONE North windfarm site, sand dredged during installation that requires disposal would be deposited at an agreed disposal site as close as practical to the installation operations. It is anticipated that the Applicant will seek to designate the East Anglia ONE North windfarm site as a disposal site. However, for locations requiring significant excavation, it is likely that some of this dredged material would be used later for infill works, and as ballast material. It is anticipated that the Applicant will also seek for the offshore cable corridor to be designated as a disposal site in respect of (dredged materials / materials arising) as a result of cable installation activities.

6.5.15 Offshore Infrastructure Construction Sequence

215. The key stages associated with the installation of the offshore windfarm, which may be conducted simultaneously or consecutively, are likely to be as follows:

- Detailed pre-construction site investigations (e.g. cone penetration tests, boreholes and high-resolution geophysical surveys);
- Installation of foundations (See Section 6.5.4);
- Installation of transition pieces;
- Installation of offshore electrical platforms;
- Installation of inter-array cables;
- Installation of platform link cables;
- Installation of wind turbine generators; and
- Installation of the monitoring meteorological mast.

216. The offshore export cables would either be installed separately or in parallel with other elements of the offshore windfarm (see ***section 6.5.11***). Prior to installation of the offshore export cables some ground preparation may be required along the route.

6.5.15.1 Pre-Construction Site Investigations

217. Pre-construction site investigations would be completed prior to construction and could include:

- Geotechnical survey

- Geophysical survey;
- UXO clearance; and
- Remotely Operated Vehicle (ROV) survey.

218. Geophysical survey data would inform the micro siting of wind turbine foundations, cables and offshore electrical platforms. The geophysical data would also serve to identify the location of sand waves within the East Anglia ONE North windfarm site and offshore cable corridor so that an assessment could be made as to whether such features could be avoided or, if not, what level of sea bed preparation (pre-lay sweeping) is required, and what the appropriate burial depth would be in stable (i.e. non-mobile) sea bed conditions.

219. Targeted geotechnical surveys would take place and would involve a number of boreholes, cone penetration tests (CPT) and vibro-cores within the East Anglia ONE North windfarm site and offshore cable corridor up to the landfall site.

220. A pre-lay grapnel run (PLGR) and ROV survey would take place to identify any obstacles that may be in the path of the proposed cable routes. If an obstacle is detected it would either be removed or the cable would be installed in such a way as to avoid it. Where the obstacle is suspected to be unexploded ordnance (UXO), specialist mitigation would be employed to either avoid or make the obstruction safe.

6.5.15.2 Construction

221. It is anticipated that the installation of the offshore elements would take approximately 27 months. Construction works would be undertaken 24 hours a day and seven days a week offshore, dependent upon weather conditions.

6.5.15.2.1 Installation of Foundations

222. The time taken to install foundations would vary depending on the type and installation method chosen. Indicative foundation installation timescales for piled foundations are presented in ***Table 6.24***. Up to three foundation installation vessels could be used at the same time to install a single foundation.

Table 6.24 Indicative Time Periods for Piled Foundation Installation

Foundation Type	Active piling time per wind turbine (hr)	Maximum worst case scenario total installation time (hr)*
Jackets with pin piles	12.6	605
Monopile	5.25	252

*This is the amount of time for piling activity and does not take into account downtime of transit of installation vessels or ground preparation time

6.5.15.2.2 Installation of Transition Pieces (TP) and Towers

223. Following foundation installation, TPs would be fixed to the top of the foundation. The TP facilitates the connection between the foundation and the tower.

224. Both TPs and towers would be either transported to site and installed by the installation vessel or transported on a barge where they would be lifted off and installed by crane on a separate installation vessel. The most likely installation vessel would be a jack-up vessel, although DP vessels are also under consideration.

225. The TP serves several different purposes as it could be used to house the necessary electrical and communication equipment and provide a landing facility for personnel and equipment from marine vessels.

226. The design and specifications of a TP are dependent on the type of foundation on which they sit. For jackets and gravity base structure foundations the TP is often integrated with the foundation at fabrication stage, and therefore there is no additional installation process. For monopiles however a TP cannot be located on the foundation as the top side needs to be clear to allow it to be driven into the sea bed.

227. Once the TPs are in place the wind turbine tower would be lowered into place using a heavy lift vessel.

6.5.15.2.3 Installation of Wind Turbines

228. The nacelle and wind turbine blades would either be transported to site and installed by the installation vessel or transported on a barge where they would be lifted off and installed by crane on a separate installation vessel. The installation of the wind turbines would typically involve multiple lifting operations, with up to three tower sections erected, followed by the nacelle with pre-assembled hub, and then the blades.

229. ***Plate 6.9*** shows an example of a wind turbine under construction, TP tower, nacelle and the blades have all been installed and a gangway is in place permitting worker access to the tower.

Plate 6.9 Wind Turbine under Construction (photo taken from West of Duddon Sands offshore windfarm)

230. Installation of each wind turbine onto the pre-installed foundation is expected to take approximately one day, excluding transit times and weather downtime. To reduce time spent at sea installing the wind turbines, pre-commissioning works onshore would be maximised.

231. Traditional installation methods consist of tower segments lifted in place and bolted together, hub and nacelle conjoined in case of single blade installation. Also, alternative installations would be considered, such as the two bladed 'bunny ears' formation (where two blades are pre-installed on the hub) and the 'star' formation (three bladed pre-installed to the hub).

232. Although not current practice, it is possible that wind turbines could be fully assembled and commissioned onshore and transported to site as a single unit installation. This method is being explored by the wind industry but it is not possible to commit to this method as it is not technically proven at this stage.

6.5.16 Offshore Maintenance

6.5.16.1 Maintenance Activities

233. All offshore infrastructure including wind turbines, foundations, cables and offshore electrical platforms would be monitored and maintained during the lifetime of the project to maximise efficiency.

234. The operation and control of the windfarm would be managed by a Supervisory Control and Data Acquisition (SCADA) system, connecting each wind turbine to the onshore control room. The SCADA system would enable the remote control of individual wind turbines, the windfarm in general, as well as remote interrogation, information transfer, storage and the shutdown or restart of any wind turbine if required.

235. There are a number of potential maintenance strategies for the windfarm. The windfarm could be maintained from shore using a number of varying O&M vessels (e.g. crew transfer vessels, supply vessels) and / or helicopters – i.e. the onshore option. Alternatively, the windfarm could be maintained primarily from an offshore base, for example a mother ship (a large offshore service vessel (possibly of the jack-up type) or a standalone construction, operation and maintenance platform within the project boundary) with transfer vessels or helicopters used to transfer personnel to or from wind turbines and platforms – i.e. the offshore option.

236. Alternatively, a combination of the onshore and offshore O&M options described above may be employed.

237. Given the design life of the offshore components, some refurbishment or replacement would be required during the lifetime of the project. Details of the anticipated maintenance requirements will be included in the outline offshore operation and maintenance plan (OOOMP).

238. Typical maintenance activities would include; general wind turbine service; oil sampling / change; UPS (uninterruptible power supply)-battery change; service and inspections of wind turbine safety equipment, nacelle crane, service lift, HV system, blades; major overhauls (years five, seven, 10), wind turbine repairs and restarts. The worst case scenario assumes that there will be one visit every two years to each wind turbine that requires the use of a jack-up vessel.

239. During the life of the project, it is not the intention to repair or replace the sub-sea cables, however repairs may be required and periodic inspection will be undertaken. Periodic surveys would also be required to ensure the cables remain buried and if they do become exposed, re-burial works would be undertaken. The worst case scenario estimates a maximum of five annual maintenance activities that will require a cable laying vessel. Additionally, there will be a maximum of four annual geophysical surveys to inspect cable burial and scour.

6.5.16.2 Vessel and Helicopter Operations

240. A number of vessel and / or helicopter visits to each wind turbine would be required each year to allow for scheduled and unscheduled maintenance. The approximate number of annual helicopter roundtrips to the East Anglia ONE

North windfarm site would be 981. For windfarm support vessels, it is expected that approximately 647 roundtrips would be required which includes all scheduled and unscheduled maintenance. If the onshore operation option is chosen, this would mean small crew vessels sailing to and from the windfarm on a daily basis from shore, possibly supported by helicopters. If the offshore operation option is preferred, the majority of small crew vessels would be operated on a daily basis from the offshore accommodation vessel or platform, although further support vessels are also still likely to transit to and from shore each day and helicopter operations may still be utilised. Electrical platforms are anticipated to require one visit a week.

241. Although it is not anticipated that large components (e.g. wind turbine blades or offshore electrical platforms transformers) would require replacement during the operational phase, it is a possibility. Should this be required, large jack-up vessels may need to operate continuously for significant periods to carry out these major maintenance activities.

242. During O&M activities SPR would seek to agree appropriate safety zones around wind turbines and work areas to be applied. Safety zones are described above in ***section 6.5.12.***

6.5.16.3 O&M Port

243. The O&M facility is to be located in a service port (yet to be chosen). It is envisaged that O&M needs, in terms of laydown areas and facilities would be minimal compared to requirements during the construction phase.

244. In the event of major intervention where large components are needed (blades, gearboxes, generators), SPR would aim to minimise the number of spares it keeps, and to supply such components directly to site from the supplier's works.

245. An office, storage or warehouse facility and quayside loading area would be needed. During the operational years of the project, operations might be coordinated and implemented from the onshore facility. Alternatively, some personnel and accommodation and O&M facilities may be undertaken offshore, either from temporary platforms such as an accommodation vessel, or from a permanent structure sure as designated construction, operation and maintenance platform.

6.5.17 Offshore Decommissioning

246. At the end of operational phase, it is a condition of the lease as well as a statutory requirement (through the provisions of the Energy Act 2004 (as amended) that the proposed East Anglia ONE North project is decommissioned.

247. The scope of the decommissioning works would be determined by the relevant legislation and guidance at the time of decommissioning and would most likely

involve removal of the accessible installed components. Offshore this is likely to include; all of the wind turbine components, part of the foundations (from 1-2m below sea bed level) and the sections of the inter-array cables close to the offshore structures, as well as sections of the export cables.

248. Details for decommissioning of offshore foundations are discussed throughout ***section 6.5.4***.

249. With regards to offshore cabling, general UK practice would be followed i.e. buried cables would simply be cut at the ends and left *in-situ*.

250. Based on previous estimates and experience, it is anticipated that decommissioning of the proposed East Anglia ONE North project would occur in stages.

6.6 Landfall

6.6.1 Site and Project Description

251. It is proposed that up to two offshore export cables would make landfall north of Thorpeness in Suffolk. This landfall location was identified based on an appraisal of a wider stretch of coastline and appropriate consultation.

252. A detailed description of the site selection process is presented in ***Chapter 4 Site Selection and Assessment of Alternatives*** but in summary, this site was chosen based on an appraisal of constraints and engineering feasibility from both offshore and onshore perspectives.

253. Indicative project characteristics for the proposed East Anglia ONE North project at the landfall are detailed in ***Table 6.25***.

Table 6.25 Indicative Proposed East Anglia ONE North Project Characteristics at Landfall

Landfall	
Landfall location	North of Thorpeness Village
Method for crossing intertidal area	Horizontal Directional Drilling (HDD)
Number of ducts	4
Number of underground transition bays	2

254. The East Anglia ONE North landfall is characterised by a shingle beach at the wave break point, with a raised terrace of shingle at the base of low lying cliffs (approximately 10m above ordnance datum) which are partially vegetated by grasses, gorse and other small shrubs. The beach is designated as a Site of Special Scientific Interest (SSSI) for a rich mosaic of habitats including acid grassland, heath, scrub, woodland, fen, open water and vegetated shingle, which is under the careful management of Natural England. There are no formal coastal

defences associated with flood prevention or coastal stability at the landfall location.

255. The transition bays would be located in arable farmland.

256. Off-site and directly south of the landfall on the cliff is Thorpeness Village. North is the residential property Ness House.

6.6.2 Operational vehicle movements

257. Operational vehicle movements have not been considered in the PEIR, in respect of the landfall, as regular maintenance is not anticipated to be required. In the event that limited maintenance is required, this would be through the use of light four-wheel drive commercial vehicles using existing access tracks.

6.6.3 Landfall Project Description

258. HDD operations will be needed to install the ducts required which would accommodate up to two export cables, and two FO cables, associated with the proposed East Anglia ONE North project.

259. At the landfall the Applicant anticipates that the cable ducts would be installed with a minimum setback distance of 85m from the cliff top to ensure the integrity of the cliff is not compromised and to allow for natural coastal erosion. The end of the HDD ducts would be buried under the sea bed beyond the intertidal zone. Offshore export cables and fibre optic cables will either be installed within the ducts once the ducts are installed or the ducts would be capped and left within the sea bed until the offshore export cables and/or fibre optic cables are installed within the ducts at a later date.

6.6.3.1 Horizontal Directional Drilling (HDD)

260. HDD involves a three-stage process as outlined below. The precise method of HDD operations will be influenced by ground conditions, equipment used and the construction methodology adopted by the HDD contractor.

1) The first stage drills a small diameter pilot bore along the designated route;
2) The second stage enlarges the bore by passing a larger cutting tool known as the reamer through the bore a number of times to progressively enlarge the bore to the requirement diameter; and
3) The third stage places the duct in the enlarged hole (the offshore export cable and/or fibre optic cables will then be pulled through this duct once the duct is installed or at a later stage in the works).

261. HDD is undertaken with the help of a viscous fluid known as drilling fluid. It is typically a mixture of water and bentonite or polymer continuously pumped to the cutting head or drill bit to facilitate the removal of cuttings, stabilise the borehole, cool the cutting head, and lubricate the passage of the duct.

6.6.3.1.1 Drilling the profile

262. A small diameter pilot hole is drilled under directional control along a predetermined path using a mud-motor or jet bit on the end of the pilot string. As the pilot hole extends through the upper layer of ground (typically top soil and made ground), casing (typically a metal pipe or collar around 100m long) may be added to the bore to assist in maintaining the integrity of this upper ground layer. Pilot hole drilling operations continue until the exit point is approached, although the pilot hole will not break through the final section of seabed. Then the smaller pilot string is removed with the casing (if used).

6.6.3.1.2 Enlarging the hole

263. Reaming operations are carried out to enlarge the drilled hole to a size suitable for accepting the duct. Depending upon the duct diameter to be installed, several reaming operations may be necessary, each progressively enlarging the hole. Reaming will progress the hole to the break out point on the sea bed. Typically, reaming takes place in a forward direction, from the HDD rig outward along the pilot hole and back, but may also be undertaken from an offshore support vessel towards the HDD rig.

6.6.3.1.3 Installing the duct

264. The pull-back duct is connected to a 'cleaning' reamer, which in turn connects to a swivel joint (to prevent pipe rotation) that is attached to the towhead fixed to the duct. The drill rig is then used to pull the duct (at this stage positioned on the sea bed or floating on the sea) into the preformed hole towards the HDD rig. The drilling fluid will consist of water and clay minerals. Once the duct is installed, the ends would be covered or plugged until the offshore export cable is ready to be installed. The offshore export cable is then passed through the duct (see ***Plate 6.10***).

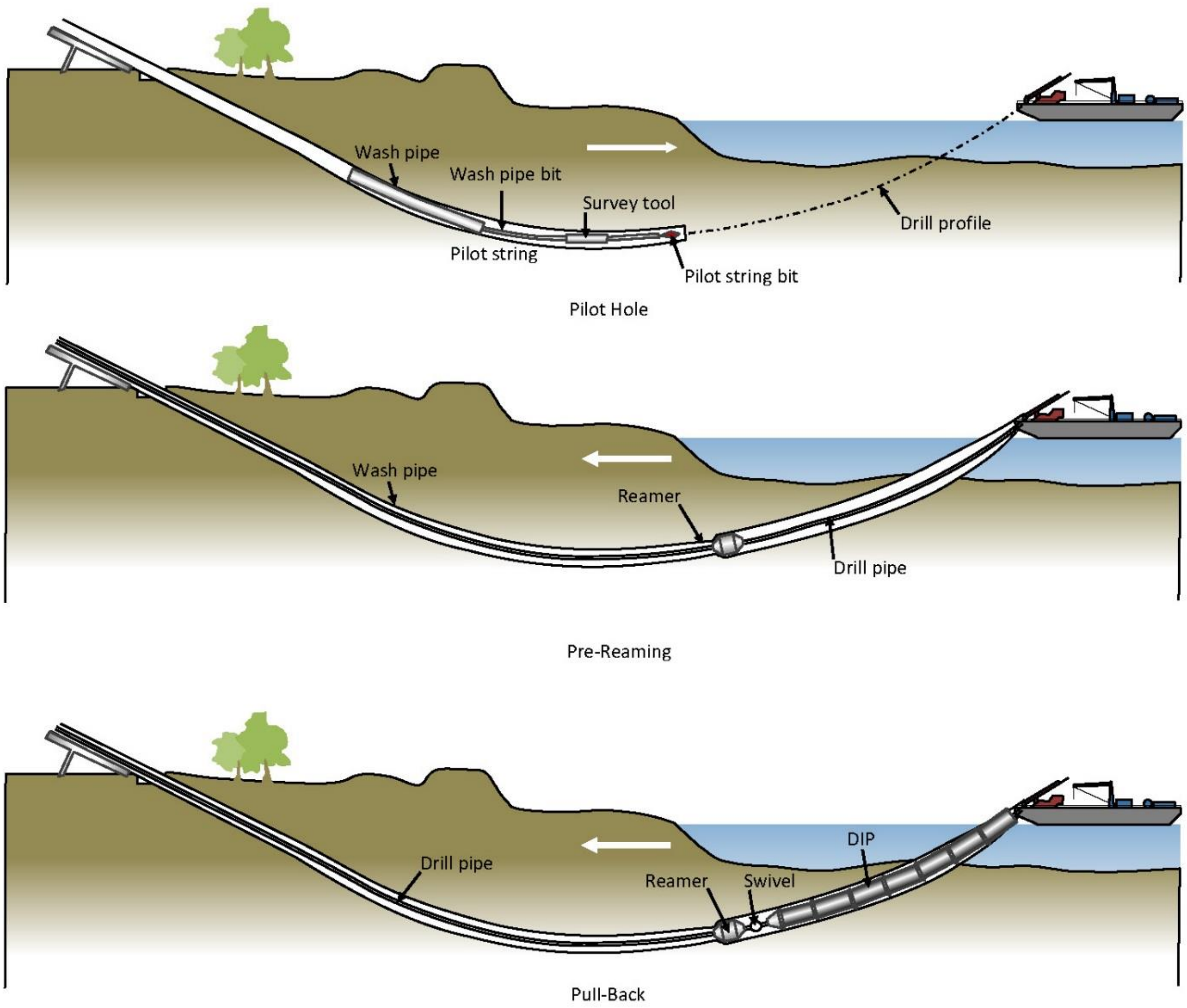


Plate 6.10 HDD working method at landfall

265. After installation, the duct may be backfilled and surrounded with bentonite or similar material for thermal resistivity purposes.

266. The maximum length of the HDD bore feasible is governed by the mechanical design limits on the offshore export cable (i.e. the length of offshore export cable that can be pulled through the duct without causing damage to the offshore export cable) and the drill profile (i.e. the angle of the bore).

267. The installation by HDD would require a fenced temporary construction compound to be set up which is anticipated to be approximately 100m x 70m in size. A Construction Consolidation Site (CCS) to serve the HDD area will also be required, measuring approximately 160m x 115m. There is an additional construction excavation footprint of 42m x 37m for the installation of the transition bays.

268. The HDD works would progress with the following stages:

- Mobilise equipment to landfall site and prepare temporary construction base including hardstanding, temporary office cabins and bunded fuelling areas;
- Position HDD rig adjacent to joining pit and drill a pilot hole from the joining pit;
- Enlarge the pilot hole by pre-reaming;
- Install the duct in the enlarged hole, and install messenger wire and winch cable for cable installation within the duct;
- If required, drawback of the offshore duct end and natural burial by sandy sediments until the offshore export cable is ready to be pulled into the duct; and
- Demobilise construction equipment and reinstate the site to its previous condition.

269. Once the export cable is ready to be installed in the duct at the landfall, the following steps would be required:

- Upon arrival of the export cable installation vessel, the duct exit would require to be exposed. This would most likely be achieved using a mass flow excavator (a submersible tool used to clear sediment without damaging the duct).
- The export cable installation vessel would be positioned by anchors prior to undertaking the cable pull in operation.
- Following completion of the pull in operation (and subsequent termination and cable testing) the offshore export cable installation vessel would commence cable lay operations for the remainder of the offshore export cable. If cables are installed as bundled pairs, then trenching is the most likely means of cable protection in this area. Whilst for single cables, ploughing would be the preferable means of burial due to the nature of the sea bed in this area.
- Subsequent to the cable lay operations, the cable in the transition zone between the HDD duct and full depth of cable trench would be lowered utilising diver-based jet lancing and dredging operations, most likely supported from a small anchored or spudded barge.

6.6.3.2 Transition Bays

270. It is anticipated that two transition bays would be installed at the landfall with a minimum setback distance of 85m from the cliff top to ensure the integrity of the cliff is not compromised and to allow for natural coastal erosion. Each transition bay would comprise a buried concrete-lined structure. The purpose of the

transition bay at the landfall would be to provide housing for the joints between the heavily armoured offshore export cables and the onshore cables.

271. The installation of the two transition bays would involve:

- Removal of the topsoil.
- Mechanical excavation of the transition bay (excavation would be slightly larger than the transition bay dimensions). Excavated material may either be used as backfill or removed from the site and suitably disposed of.
- Construction of concrete transition bay chamber floor and walls. This would involve either the installation of shuttered walls, reinforcement and poured concrete (which would be transported to the site) and the shuttering would be removed once the concrete is suitably cured); or the installation of precast concrete walls.
- Temporary backfill (with sand or similar) of the transition bay chamber until the offshore export cables and onshore cables are installed.

272. Each transition bay would be up to 6m in width, 1.8m in height and 21m in length. Each transition bay would be buried underground to an approximate depth of 3m (the top of the transition bay being approximately 1.2m below ground level). The excavation to install both transition bays could be up to 37m in width, 3m in depth and 42m in length. The land would be reinstated following construction.

273. Access to the cables for maintenance would be by manhole or other suitable access cover.

6.6.3.3 Construction Traffic and Plant

274. Access to the landfall will be via Thorpeness Road and / or Sizewell Gap Road. Details of vehicle movements for construction at the landfall are provided in ***Chapter 27 Traffic and Transport***.

275. For HDD operations, plant would include (for a full list of assumed plant see ***Appendix 25.2***):

- Mud separation unit;
- Drill rig;
- Tractors;
- Excavator;
- Generators and pumps;
- Telehandler; and
- Dumper.

276. For the transition bays, plant would include (for a full list of assumed plant see ***Appendix 25.2***):

- Dozer;
- Tractors and trailers;
- Excavator;
- Generators and pumps;
- Telehandler; and
- Dumper.

6.6.3.4 Lighting

277. It has been assumed that 24-hour lighting would be required during HDD operations for both security and task lighting purposes.

6.6.3.5 Workforce

278. The total number of construction employees required has been estimated at an average of 11 (with a peak of 30), assuming one drill rig operating over the construction duration at the landfall.

6.6.3.6 Reinstatement

279. The construction compound would be reinstated to its former condition. If necessary, the subsoil would be ripped prior to topsoil placement if compaction has occurred. Topsoil would be spread in such a way as to ensure that it does not become compacted.

6.6.4 Operation and Maintenance

280. Routine maintenance is anticipated to consist of one annual visit to each transition bay to carry out integrity testing, which would be accessed via man-hole covers, and possible non-intrusive checking of the cable with, for instance, ground penetrating radar.

281. Appropriate off-road vehicles would be used to access each transition bay.

282. Non-scheduled maintenance to address faults as and when these may arise would also be necessary. Appropriate off-road vehicles would be used for access.

6.6.5 Decommissioning

283. With regards to offshore export cables, general UK practice would be followed, i.e. buried cables would simply be cut at the ends and left *in-situ*. It is considered that full removal of the buried cables would have a more damaging environmental impact than is the case when leaving them *in-situ*. In the nearshore, if there is a

risk of cables being exposed over time they may need to be removed via excavation or jetting.

284. The transition bays would also be left *in-situ*.

6.7 Onshore

6.7.1 Onshore Cable Route: Site Description

285. The proposed route for the onshore cables is approximately 9km long and is shown in ***Figure 6.2***.

286. A full description of the onshore cable route is provided below.

287. Commencing at the transition bay approximately 500m north of the edge of Thorpeness the onshore cable route runs in a northern direction, crossing three local tracks as it travels approximately 1.5km through agricultural land (comprising small irregular shaped fields) parallel to the edge of the Leiston – Aldeburgh SSSI and Sandings SPA and coastline.

288. Approximately 1.5km from the landfall, the onshore cable route turns in a western direction and crosses the Leiston – Aldeburgh SSSI and Sandings SPA. After crossing the SSSI and SPA, the route runs in a south westerly direction for approximately 2km, crossing the dismantled railway, through agricultural land.

289. The onshore cable route crosses the B1353 Thorpeness Road and continues in a south westerly direction to the crossing point of the Hundred River and then turns immediately west to the crossing point of the B1122 Aldeburgh Road.

290. Immediately after crossing the B1122 Aldeburgh Road the onshore cable route continues west through the woodland belt south of Aldringham Court Nursing Home for approximately 350m. It should be noted that the proposed onshore development area has been narrowed at this point to minimise the interaction with woodland and potential environmental impacts.

291. After passing through the woodland belt the route continues in a westerly direction for approximately 1km passing through agricultural fields, travelling south of Coldfair Green until the crossing point of Sloe Lane and, further west, the crossing point of the B1069 Snape Road.

292. From the crossing of the B1069 Snape Road, the onshore cable route turns in a north westerly direction for approximately 1.5km crossing more agricultural fields until the crossing point of Grove Road before turning immediately north for approximately 300m before reaching the proposed East Anglia ONE North substation location. During this final section, the route travels across agricultural land.

6.7.2 Onshore Cable Route: Project Description

293. This section describes the infrastructure that constitutes the onshore cable route, alongside the proposed construction, operation and decommissioning methodologies associated with this infrastructure.

6.7.2.1 Cables and Ducts

294. There would be up to six onshore cables and two FO cables, laid in two trenches (three onshore cables and one FO cable in each trench). Cables will be installed approximately 1.2m below ground level, to transport the electrical power from the landfall to the onshore substation location. Cables may be placed directly underground without ducting, although ducting may be used in some or all of the route. Cables would typically be up to 170mm in diameter (the ducts being larger).

295. Each cable trench will require distributed temperature sensing (DTS) cabling to be installed next to the ducts or cables. Typically, this system comprises of a fibre optic cable within a protective sheath. The DTS identifies faults in the buried cables during operation, allowing the precise location of any fault to be identified and more accurate excavation of the ground to facilitate the cable repair.

6.7.2.2 Cable Jointing and Jointing Bays

296. Onshore cabling is typically provided on drums of up to 1,000m in length with a length range of 500m up to 2,000m. Buried jointing bays will be required along the onshore cable route to join each section of the cable together.

297. These buried jointing bays (which will be approximately 15m long x 3m wide x 1.7m deep) will be constructed at intervals along the onshore cable route (to allow cable pulling and jointing at a later stage). The precise location of the jointing bays will be determined during detailed design; however, wherever possible the jointing bays will be located at the edge of field boundaries or roads to allow future access.

298. It is likely that some access to the buried joints would be required for routine integrity testing. Access could take the form of an inspection pit with a manhole access cover visible at surface. This would be situated close to field boundaries (or other suitable markers) in order to minimise visual impact.

299. For the purposes of a worst case assessment of impacts, each of the chapters dealing with onshore infrastructure has assumed a worst case of 36 jointing bay locations (two jointing bays (one jointing bay per trench) every 500m, plus two jointing bays at each onshore HDD location (one jointing bay per trench)).

6.7.3 Construction Methods for the Onshore Cable Route

300. Underground cable installation is well-established and aside from the engineering challenges it incorporates environmental management and mitigation measures

as standard practice. All aspects of the construction work will be in accordance with the Construction (Design and Management) Regulations 2015.

301. Precise construction methods would differ according to the nature of the environment through which the onshore cable route was being constructed. Of particular importance are the underlying soils and strata, existing hydrological regimes, the terrain, existing physical constraints (such as other underground services) and environmental constraints (such as development or environmentally sensitive areas).

302. The onshore cables for East Anglia ONE North would be installed in two parallel trenches with sand and originally excavated backfill, where suitable.

303. Concrete cable protection tiles (or similar) would be fitted above the cables in each trench, featuring indented lettering warning of the danger of electricity below. Between the protection tiles and the ground surface would be plastic warning tape containing text alerting future excavators to the danger of the cables below.

304. Construction activities would be undertaken within a temporarily fenced strip of land, known as the working width, which would generally be no wider than 32m.

6.7.3.1 Cable route working width

305. The working width is determined by electrical and civil engineering considerations. Underground cables generate heat which dissipates naturally to the surrounding ground during power transmission. If cables become too hot their current carrying capacity (rating) diminishes and they will not operate efficiently. Ultimately, an overheated cable may fail in service. The need to keep cable conductors from becoming too hot requires them to be separated from each other underground.

306. The working width of 32m for the onshore cable route incorporates sufficient spacing between cable trenches to prevent cable overheating, plus room for temporary construction works. The room for temporary construction works incorporates storage space for excavated material and a haul road for the safe passage of construction personnel and machinery alongside the cable trench. In some sections the working width would vary in order to allow special construction techniques.

307. Deliveries of construction materials and personnel along the onshore cable route would be via the use of a temporary haul road within the working width. This haul road would run between Construction Consolidation Sites (CCSs), located at access points along the onshore cable route. These CCSs would be temporary site compounds providing facilities for the construction workforce and secure storage areas for materials. If cables were to be pulled through ducts (rather than

via a direct lay method), pulling operations would also be carried out from within the working width. Cables would be delivered via the haul road and taken by tractor or drum trailer to jointing bays for pulling operations.

6.7.3.1.1 Reduced cable route working width

308. The typical 32m working width would be reduced to 16.1m when crossing important hedgerows and through the Aldeburgh Road woodland by applying a range of special engineering techniques that could include:

- Using lower thermal resistivity backfill in the cable trench; and
- Removing the spoil to a remote storage area further up or down the onshore cable route (away from the reduced working width location), thereby negating the need to store spoil adjacent to the trenches.

6.7.3.1.2 Widened cable route working width

309. The typical 32m working width would be widened if a HDD technique is utilised to cross the Leiston – Aldeburgh SSSI and Sandlings SPA.

310. The working width would also be widened at locations where spoil (from the reduced working width sections) is moved to.

311. An indicative cross section of the typical working width of the onshore cable route is shown in ***Plate 6.11***. An indicative cross section of the reduced working width for the onshore cable route is shown in ***Plate 6.12***.

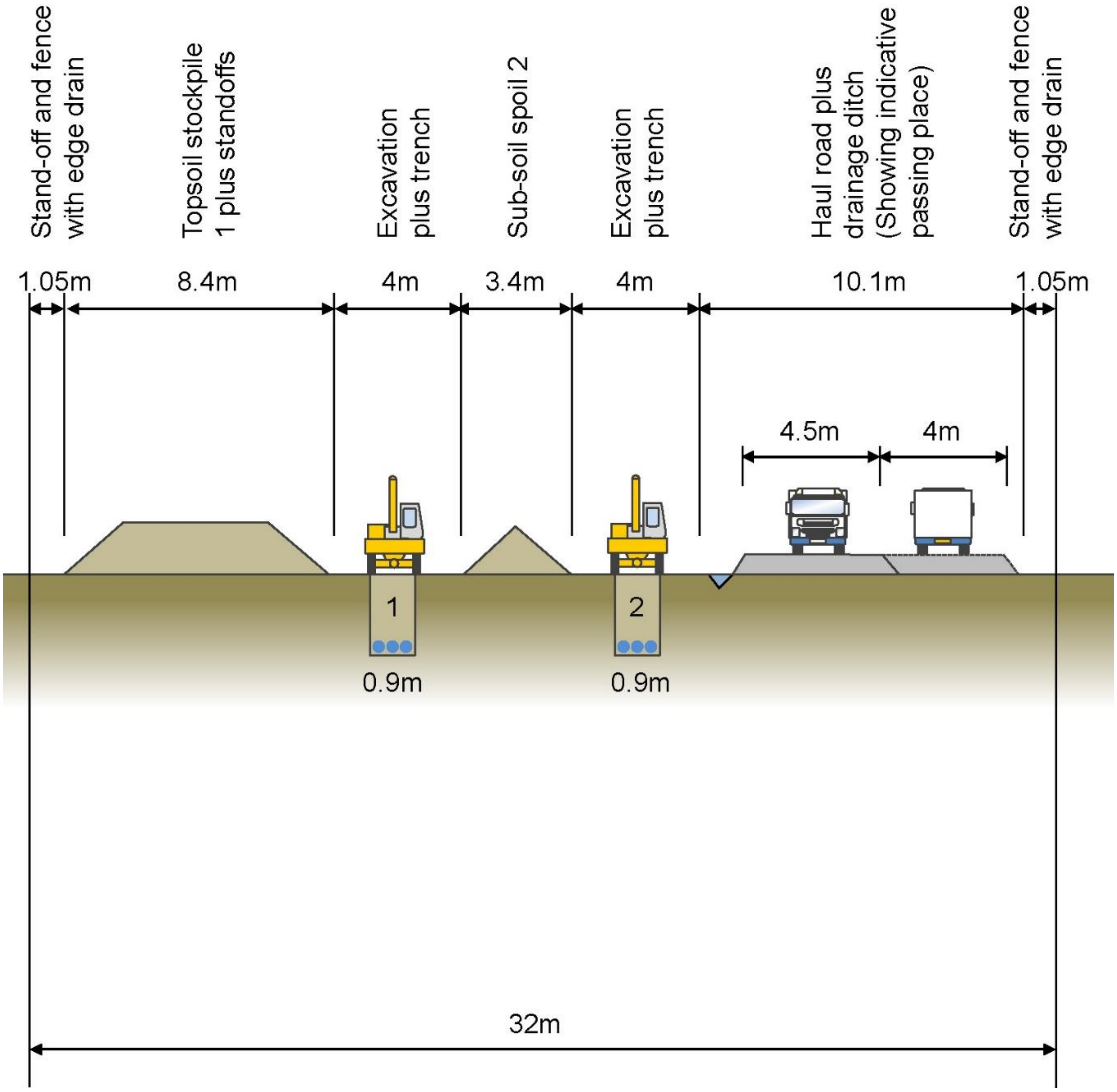


Plate 6.11 Indicative cable trenching arrangement and working area for typical working width (East Anglia ONE North only)

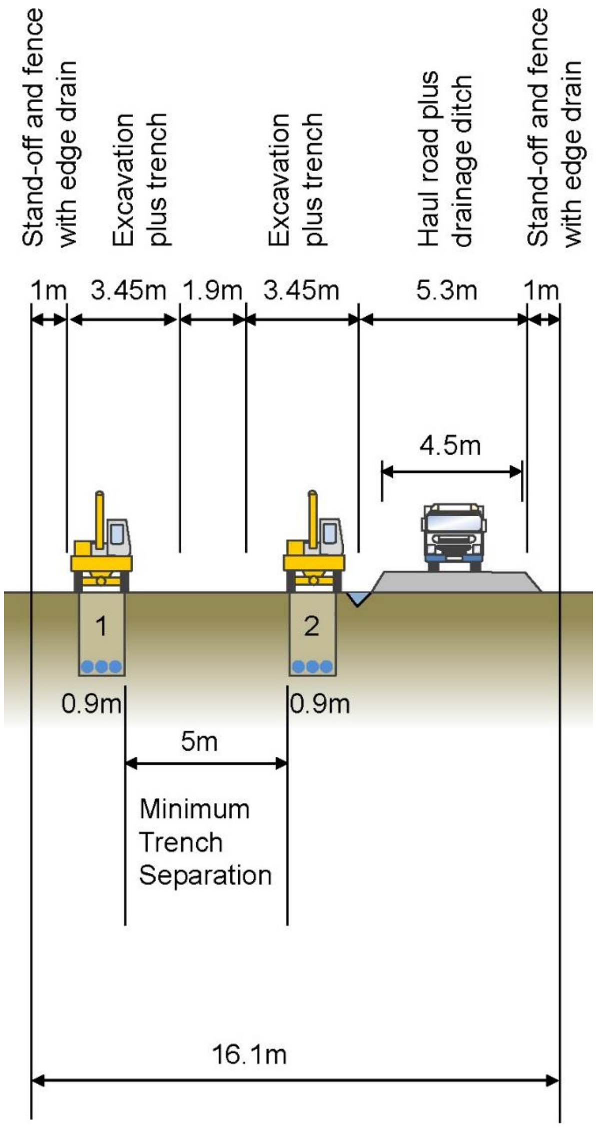


Plate 6.12 Indicative cable trenching arrangement and working area for reduced working width (East Anglia ONE North only)

312. The following sections describe in sequence the steps involved in standard cable construction technique.

6.7.3.2 Pre-construction Works

313. Pre-construction activities would include the following:

- Road Modifications – New junctions off existing highways would be required (see ***section 6.7.3.3*** for detail). Installing these ahead of the main works provides immediate access to the CCSs. In addition, offsite highway improvements would be required to facilitate access of Heavy Goods Vehicles (HGVs) and Abnormal Indivisible Loads (AILs) to the CCSs.
- Topographic surveys (for engineering purposes);

- Ecological pre-construction work (including, for instance, hedgerow removal or creation of mitigation badger setts);
- Archaeological pre-construction work;
- Drainage surveys;
- Geotechnical and ground stability surveys;
- Welfare facilities for pre-construction works; and
- Pre-entry records and requirements for landowner condition records.

314. Accesses for all pre-construction works are identified in ***Figure 6.6 (a-j)*** as 'Pre-construction Access'.

315. Prior to commencement of construction works, it is anticipated the construction contractor would record the condition of roads, tracks, land, fences, etc., by means of schedules and photographic or video surveys. The details of infrastructure (such as water pipes) collated during the EIA process would be reviewed, in addition to a review of unrecorded services such as land drains and irrigation systems.

316. The information from such surveys would form the basis for agreement on final reinstatement of the land after construction.

6.7.3.3 Road Modifications

6.7.3.3.1 Onshore cable route access

317. Road modifications could be required to facilitate the safe ingress and egress from the public highways to the onshore cable route or CCSs through construction accesses. Traffic and transport assessments have identified eight locations for where these additional accesses may be required, and further assessment will be undertaken post consent based on the final design of the project. An Outline Access Management Plan will be submitted with the DCO application. Accesses are expected to be located at each CCS and intersections between the public highway and cable route, where suitable, to facilitate access to the onshore cable route. These are identified as Access IDs in ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***.

318. Additionally, four locations have been identified where the cable route crosses the public highways. These locations are identified as Crossing IDs within ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***. Ingress or egress will not be sought at the Crossing IDs at Thorpeness Road and Grove Road, and traffic management will be employed to ensure safe crossing of the public highway by construction traffic along the onshore cable route haul road (including the Crossing ID locations on Aldeburgh Road and Snape Road).

319. Where possible the accesses make use of existing tracks to link between the public road network and the onshore cable route. There may be a requirement to upgrade some existing tracks to make them suitable. Where this is required it would be completed using a design which is suitable for construction traffic.

6.7.3.3.2 Offsite highway improvements

320. In order to facilitate construction traffic and / or construction-related deliveries, highway modifications may be required at locations on the existing public road network. The purpose of the modifications would be to allow larger vehicles than normal to access certain parts of the public road network. It is anticipated that the works would be concentrated at junctions.

321. It is anticipated that the modifications would be completed prior to construction starting within relevant sections of the onshore cable route.

322. The modifications could potentially comprise:

- Structural works to accommodate Abnormal Indivisible Loads;
- Localised widening / creation of overrun areas;
- Temporary moving or socketing of street signs; and
- Temporary moving of street furniture.

323. Any modifications to roads would be undertaken in consultation with and in accordance with the requirements of the local Highways Authority.

6.7.3.4 Preparation of the Working Width

324. Temporary fences would be erected along the boundaries of the working width. The type of fencing to be used would be determined through consultation with the landowner/occupier. Gates and stiles would be incorporated as appropriate (for example, where farm access will be maintained). ***Plate 6.13*** shows an example image of a temporary fence that could be utilised along the boundary of the working width.

Plate 6.13 Example of a temporary fence used to delineate the boundary of the cable route working width (image taken from East Anglia ONE project)

325. High visibility fencing would be installed to denote infrastructure crossings (such as gas pipelines or overhead power lines).

6.7.3.5 Topsoil Stripping

326. Once the working width has been cleared of vegetation, the topsoil would be stripped. The precise method of stripping and the depth to which the soil would be stripped would be determined during detailed design. The topsoil would be stored to one side of the working width in such a way that it is not mixed with subsoil. Typically, this would be in an earth bund of an approximate height of 2m to avoid compaction from the weight of the soil. Storage time would be kept to the practicable minimum to prevent the soil deteriorating in quality. Topsoil

stripped from different fields would be stored separately where possible, as would soil from hedgerow banks or woodland strips.

327. Particular care would be taken to ensure that the existing land drainage regime was not compromised as a result of construction. Land drainage systems would be maintained during construction and reinstated on completion. Temporary cut-off drains would be installed parallel to the trench-line, before the start of construction, to intercept soil and groundwater before it reaches the cable trench. These field drains would discharge to local drainage ditches through silt traps, as appropriate, to minimise sediment release.

328. Subsoil would be excavated to the required depth for each trench. This would follow the profile of the ground surface, but deeper excavations could be required at certain crossings.

6.7.3.6 Temporary Roads

329. Temporary haul road construction would most likely involve the placement of a suitable imported material (such as aggregate onto a geotextile base and / or use of temporary mats).

6.7.3.6.1 Onshore cable route haul road (between landfall and Snape Road)

330. A temporary haul road would be installed along the onshore cable route between Snape Road and the landfall area. The onshore cable route haul road between landfall and Snape Road would be approximately 4.5m wide with passing places of 4m in width at approximately 87m intervals. The onshore cable route haul road between the landfall and Snape Road would be up to a maximum of 8.5m in width at these passing place locations. See ***Plate 6.14*** for a schematic of the haul road.

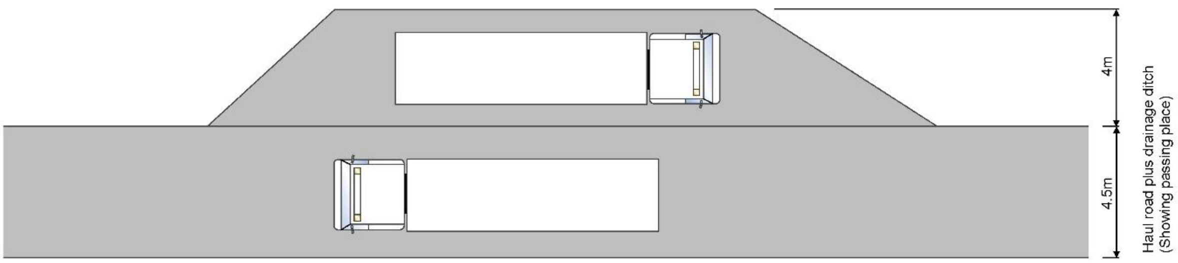


Plate 6.14 Cable route haul road schematic

6.7.3.6.2 Onshore cable route and substation construction access haul road (between Snape Road and onshore substation / National Grid substation)

331. A temporary haul road would be installed along the onshore cable route between Snape Road and the onshore substation / National Grid substation. This would facilitate access for the installation of the onshore cable route as well as for HGV construction traffic to access the onshore substation and National Grid substation during the construction phase. The onshore cable route and substation

construction access haul road between Snape Road and the onshore substation / National Grid substation would be approximately 9m in width.

6.7.3.6.3 Temporary construction access roads

332. Temporary construction access roads (similar to the haul roads) would be installed to provide access from the public highway to onshore cable route CCSs, the onshore cable route haul road and the onshore cable route and substation construction access haul road. The temporary construction access roads would be approximately 4.5m wide with passing places of 4m in width at approximately 87m intervals. The temporary construction access roads would be up to a maximum of 8.5m in width at these passing place locations.

6.7.3.7 Installation of Cables

333. Trenching would be the default installation method for the onshore cables. Cables will typically be installed in trenches approximately 1.2m below ground level.

334. The default arrangement assumes that cables (and ducts if used) are laid in trefoil (plus fibre-optic cables and DTS cabling) in a total of two trenches. The width of the trenches and the spacing between them would vary depending on the depth of burial.

335. The excavation would be carried out using a tracked excavator or similar. Any material retained would be kept separate from the previously stripped topsoil. Once backfilling of the trenches was completed, any surplus material would be removed from site and disposed of as waste as per the waste management plan.

6.7.3.8 Cable Delivery

336. Cables would be delivered in drums, with the cable lengths on the drums being specified during design and procurement phases. For significant cable lengths, i.e. in excess of 900m, specialist hauliers may be required.

337. Upon arrival at site, the drums would be offloaded into the CCS. A mobile crane would be necessary for offloading.

6.7.3.9 Cable Pulling and Installation

338. Cable drums would be delivered to CCSs, where they would be lifted from the delivery trailer onto a hard standing for temporary storage. From there, the cables would be taken by tractor and cable drum trailer to jointing bays for pulling operations. Pulling operations would be carried out within the onshore cable route working width.

339. A cable pulling system will be installed. Where cables are installed in an open trench this would typically comprise a steel bond and winching system, with free spinning cable rollers placed along the bottom of the trench. Other cable pulling systems could be employed and could comprise motorised rollers or tracked

caterpillar drives. Where cables are installed within ducts that are buried within the trench, a winch system would be used to pull each cable through the ducts at each jointing bay.

340. The cable drum would be placed on a raised spindle mounted on hydraulic jacks. The cable would then be pulled from the drum into the trench or the duct with sufficient cable pulled through to the far jointing bay to allow for jointing onto the next section.

341. This process would be repeated for the second and third cable to be installed in the trench or within the duct installed within the trench. The three cables would then be spaced in the trench in accordance with the design specification, separated by a spacer board to ensure the spacing is maintained during the backfilling process. A fibre-optic cable and DTS cable would then be spaced in the trench in accordance with the design specification.

342. Once the cables are laid, sand or Cement Bound Sand (CBS) would be laid around and over the cables or ducts, providing a typical depth of cover above the cable or duct of around 170mm. The cover tiles and warning tape would then be placed above the cables. At this point the supporting materials would be removed and backfilling would be carried out using the previously excavated material.

6.7.3.10 Special Crossings

343. Some locations may require the use of special crossing techniques where open cut trenching is not suitable due to the width and, or type of feature being crossed. With trenchless methods (such as HDD, micro tunnelling or auger boring), the depth at which the cable ducts are installed depends on the topology and geology at the crossing site.

344. As previously discussed, the landfall at Thorpeness will be HDD in order to protect the cliffs and avoid disturbance of the beach and intertidal area (see ***section 6.6***).

6.7.3.10.1 HDD

345. See ***section 6.6*** for further details regarding HDD installation methods.

346. The installation of the onshore cables by HDD (not including landfall) would require a fenced temporary construction compound approximately 100m by 70m in size.

6.7.3.10.2 Auger boring / micro-tunnelling

347. For both these techniques a circular or rectangular pit (shaft or cofferdam) is constructed each side of the feature to be crossed. These are typically 1m below the invert level of the duct to be installed. The duct is driven through the side wall

from the launch pit to a reception pit. The method of driving varies to suit prevailing ground conditions.

348. Auger boring is suitable in most cases with the exception of sands or obstructions such as cobbles or boulders. First a pilot pipe is jacked through the ground from the launch shaft to the reception shaft. An auger is attached to the end which clears the opening of soil and is itself followed by the permanent duct.

349. Micro-tunnelling involves remote control tunnel boring machines tunnelling themselves from the launch to reception shaft conveying spoil to the launch shaft via conveyors. The permanent duct immediately follows the machine, installed by jacking from the launch pit. This method can be used in most ground as the drilling head can be configured to prevailing ground conditions.

6.7.3.10.3Open cut watercourse crossings and rivers

350. The onshore cable route crosses the Hundred River and several surface drainage channels.

351. The majority of watercourse crossings would be constructed using conventional open cut methodologies, as described below. The Environment Agency would be consulted to help determine the detailed method statement governing each crossing.

352. Where possible, spoil storage would be set back 5m from water courses, to minimise potential for silt run off from the working width.

353. A number of factors would affect the choice of crossing method, including depth of water, available space, duration of works, bed conditions, accessibility and potential ingress of water. The default crossing method of watercourses would be trenching and would be considered worst case as a more intrusive method of installation that could affect the watercourse.

354. The onshore cable route haul road would traverse across the watercourse using a temporary bridge or temporary culvert, which would lie within the onshore cable route working width.

355. The exact methodology to achieve an open trench across each watercourse and the temporary bridge arrangements required would be decided by the works contractor. The profile of the trench running through the stream would be determined in consultation with, and with the approval of, the Environment Agency. Determining engineering factors would be the required cover underneath the stream bed, the surrounding stream bank profiles and the minimum bend radii of the ducting.

356. Open cut crossings can either be wet or dry. One dry technique involves damming the watercourse upstream and downstream of the crossing, thus creating a dry area where the cable crosses. Water is then pumped from where it has been impounded upstream and discharged downstream of the crossing area.

357. In the wet open cut technique, construction takes place within flowing water. The cable trench is typically constructed across the watercourse by equipment operating from either the banks or from flume pipes laid in the river to maintain flow and provide an equipment crossover from one bank to the other. After excavation of the trench, a section of ducting is placed into the trench.

358. For both techniques, timing of the works is important. Periods of low flow would be chosen wherever practicable.

359. Erosion control measures (e.g. silt fencing) would be installed and maintained until the area stabilised and vegetation became sufficiently re-established. Where there is a risk of sediment run-off, sediment interception techniques would be used.

6.7.3.10.4 Minor roads

360. Minor roads are those relating to a narrow width road such as a country lane in which the road will not accommodate two vehicles side by side so that vehicles can only pass at passing bays.

361. It is proposed that minor road crossings would in most cases be accomplished by open trenching techniques whilst maintaining one lane of through traffic at all times through temporary extension of the carriageway as described below. Alternatively, roads could be closed to through traffic, depending on the outcome of consultation with local stakeholders and residents.

362. To keep access open along the road while construction of the trenches takes place, the road could need to be temporarily widened to a width that would easily accommodate two-way traffic of large vehicles over the construction width of the cable route and for mandatory clearance for construction personnel. This would allow half of this width to be closed off to traffic while the road is trenched to half way across and cables/ducts are laid down. The second half of the road would use traffic management signals to keep access open to road users. The level of excavation required would be determined by standard road crossing profiles and any other services running parallel with the road at detailed design stage.

6.7.3.10.5 Major roads

363. This crossing type relates to a road suitable for two-way traffic. It follows the same method as described above for Minor Road Crossings except that generally the road will not need to be temporarily widened prior to beginning excavation

operations. This would be determined following a detailed survey of the road at the crossing point and whether there is currently enough room to close one lane and perform the excavations.

364. As an alternative, the option to temporarily close the road overnight or over a weekend will be considered as part of the assessment.

365. Standard road crossings would be trenched and would conform to the New Road and Street Works Act 1991, Part III, as appropriate.

6.7.3.10.6 Public Rights of Way (PRoW)

366. Along its length, the onshore cable route crosses 18 public rights of way (PRoW).

367. Whilst construction activities are taking place affecting a PRoW, the individual right of way would be subject to a temporary closure and / or alternative routeing in consultation with the local authority rights of way officer

6.7.3.11 Temporary Works: Construction Consolidation Sites

368. Construction Consolidation Sites (CCSs) would be required along the onshore cable route. The proposed dimensions for the cable route CCSs are 160m x 115m footprint.

369. Preliminary studies have identified six possible locations for onshore cable route CCSs within the proposed onshore development area (see ***Figure 6.6a-j***):

- Immediately to the south of the Sizewell Gap Road to the west of Home Farm;
- South of the junction between Sizewell Gap Road and King George's Avenue, to the south east of Leiston between Crown Farm and Halfway Cottages;
- Off the B1353 Thorpeness Road crossing point, immediately east of Aldeburgh Road, to the south of Aldringham Green;
- West of Aldeburgh Road and south west of the woodland block south of Aldringham Court Nursing Home; and
- Immediately east and west of the B1069 Snape Road crossing.

370. It is the intention that the CCSs would be to:

- Form the main point(s) of access onto the linear construction site;
- Provide the main areas for the storage of materials and equipment; and
- House site administration and welfare facilities for the labour resources.

371. ***Chapter 26 Traffic and Transport***, ***Appendix 26.13*** illustrates the proposed delivery routes to the cable installation works. Construction traffic is proposed to

be routed to the CCSs, and thereafter the majority of construction traffic would be carried along the temporary access roads, onshore cable route haul road and onshore cable route and substation construction access haul road.

372. In accessing CCSs, construction routes are proposed to be routed along strategic lorry roads identified within the Suffolk Lorry Route Network. From this Network, access points via local roads are proposed. Many of these local roads commonly handle large agricultural plant.

373. Wheel washing facilities would be provided at entry / exit points to haul roads, along with suitable road traffic signage both to direct construction traffic and to alert the public road users to the presence of construction traffic.

6.7.3.12 Temporary Works: Landfall Marshalling Area

374. A HGV marshalling area is proposed along the B1353 at Elm Tree Farm to act as an interchange hub for deliveries of material and equipment for the landfall HDD prior to utilising the pilot vehicle system to escort HGVs along the B1353 to the landfall. Further detail on this marshalling area is discussed in ***Chapter 26 Traffic and Transport*** and ***Appendix 26.16 Pilot Vehicle Traffic Management***.

6.7.3.13 Lighting

375. Along the length of the onshore cable route, no 24-hour lighting is anticipated to be required except that associated with HDD operations and security lighting at the CCSs. Task lighting will be utilised in localised areas where required.

6.7.3.14 Construction sequencing

376. The construction programme proposes that the onshore cable route would be subdivided into sections of 500m to 2km lengths, separated by the presence of CCSs. These CCSs would facilitate concurrent or sequential working within the four sections along the onshore cable route. Each section of work would be supplied and supported by a CCS. The extent of each of the four sections has been defined by the constraints afforded by existing natural or man-made obstructions and is shown in ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***.

377. Within each of the sections, work would be undertaken in a practical, logical and sequential manner. Wherever practical, the works would commence from one CCS and terminate at the next.

378. The sequence of construction activity within each section along the cable corridor would be:

- Site clearance and topsoil strip between fence lines (fence lines established during pre-construction works);
- Establish and prepare temporary haul road along working strip;

- Excavate trenches for direct burial and/or ducted cable;
- Excavate jointing pits;
- Install cable bedding;
- Cable / duct laying;
- Trench reinstatement;
- Cable installation within ducts (where ducts are used)
- Topsoil replacement and seeding;
- Remove temporary fencing; and
- Reinstate permanent fences and hedges.

6.7.3.15 Construction Traffic and Plant

379. A full Construction Traffic Management Plan will be developed prior to construction. This would detail temporary road closures, diversions and/or other local traffic management that may be necessary. An outline Construction Traffic Management Plan will be submitted with the DCO application.

380. An initial assessment of the number of vehicle movements[2] required (for the delivery of equipment, and personnel) associated with the construction of the onshore cable route per separate construction section has been estimated at an average of 150 movements per day for Section 1, 95 movements per day for Section 2, 75 movements per day for Section 3, and 65 movements per day for Section 4 (see ***Chapter 26 Traffic and Transport*** for further details).

6.7.3.16 Workforce

381. The construction workforce would consist primarily of specialist workers who travel to work on similar projects throughout the UK and abroad. To supplement this, local workers would be used where possible, subject to required skills being available. The total number of construction employees required has been estimated at approximately an average of 50 construction personnel per day associated with Section 1 of the onshore cable route, 30 personnel per day for Section 2, 25 personnel per day for Section 3, and 20 personnel per day for Section 4.

6.7.3.17 Reinstatement

382. The onshore cable route, CCSs and all temporary work areas/access roads would be reinstated with the stored topsoil and subsoil following trenching and commissioning and testing of the onshore infrastructure. If necessary, the subsoil

[2] A movement is the process of transporting goods from a source location to a predefined destination. A two-way movement represents the inbound (laden trip from source) and the outbound unladen trip (back to source). For example, 20 two-way movements comprise 10 laden trips from source and 10 outbound unladed trips back to source.

would be ripped or suitably tilled prior to topsoil placement if compaction had occurred. Topsoil would be spread in such a way as to ensure that it did not become compacted.

383. Following reinstatement of soil and subsoil, final restoration would commence where possible. Pasture and arable land would be reseeded, fences would be reinstated and suitable hedgerow species replanted. Hedges and any replacement planting would be carried out during the first appropriate planting season following site restoration. In ecologically sensitive areas special restoration may be necessary.

384. The onshore cable route would be marked with marker posts at field boundaries. These would be visible from the ground and all marker posts would be located to minimise interference with agricultural activities. The final stage in the cable installation process once reinstatement was established would be the removal of the temporary fencing.

6.7.4 Onshore Cable Route Operation and Maintenance

385. It is expected that normal agricultural activities would be able to continue over the onshore cable route following installation.

386. Routine maintenance is not anticipated. A worst case is considered to consist of one annual visit to jointing bays to carry out routine integrity tests; which would be accessed by man-hole covers and possible non-intrusive checking of the cable in between jointing bays with, for instance, ground penetrating radar.

387. Appropriate vehicles would be used to access each jointing bay. Jointing bays would therefore be located adjacent to field boundaries or roads as practicable.

388. Non-scheduled maintenance to address faults as and when these may arise would also be necessary, and this maintenance could be required in between jointing bays.

6.7.5 Onshore Cable Route Decommissioning

389. It is anticipated that the onshore cable would be decommissioned (de-energised) and most likely the cables left *in-situ*. It has also been assumed that the jointing bays will be left *in-situ*.

6.7.6 Onshore Substation: Site Description

390. Two substations are required for the proposed East Anglia ONE North project: one is the East Anglia ONE North onshore substation and the other is the National Grid substation. It is proposed that they will be sited adjacent to one another.

391. The purpose of the East Anglia ONE North onshore substation is to convert the electrical current from HVAC cables into appropriate voltage for the National Grid substation to connect into the electrical transmission network (overhead lines).

392. From the outset, careful siting of the onshore substation and National Grid substation has set out to avoid key areas of sensitivity wherever possible. Embedded mitigation has included:

- Careful siting of the East Anglia ONE North onshore substation and National Grid substation to the west and south of existing woodland blocks to gain maximum benefit from existing screening;
- Careful siting of the East Anglia ONE North onshore substation and National Grid substation in close proximity to the existing overhead lines to reduce additional cabling requirements and to minimise proliferation of infrastructure; and
- Siting the East Anglia ONE North onshore substation and National Grid substation in an area of low flood risk (Flood Zone 1).

6.7.7 Onshore Substation Infrastructure

393. The onshore substation would be located within a single compound. In addition to the main GIS building, the substation 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 will have an optimised layout, with the majority of equipment contained in buildings.

394. The onshore substation would be connected to the National Grid substation by means of up to two buried cables. These may be installed directly underground or within concrete troughs.

395. Lightning protection would be installed as part of the design of the onshore substation. The following potential lightning protection methods, most likely a combination, may be utilised:

- Lightning rods – short metal conductors, typically 2-5m in height and up to 30mm in diameter, which could be mounted on buildings or tall pieces of equipment. Up to 2 lightning rods per building.
- Lightning masts – standalone slender masts. The mast structure would be a single steel tubular section approximately 25m in height, up to 250mm diameter at the base and narrowing to approximately 60mm at the top of the mast with a short lightning rod, typically 2-3m mounted at the tip. Up to 6 lighting masts may be required for the site.

- Shield wires – uninsulated wires spanning over electrical equipment.

396. Further detail will be provided in the ES and an assessment conducted where required.

397. ***Table 6.26*** outlines key design parameters for the onshore substation including outline landscaping measures. These represent the maximum dimensions. The Applicant's preferred arrangement of onshore substation is shown in ***Figure 6.5***.

Table 6.26 East Anglia ONE North onshore substation key parameters

Parameter	Specification
Maximum building height	15m to the highest ridge
Substation compound dimensions	Up to a maximum of 190m (width) x 190m (length)
Maximum height of external electrical equipment	18m
Height of landscape bunding	Approximately 3m above ground level
Heights of tree growth	Approximately 300mm per year following planting

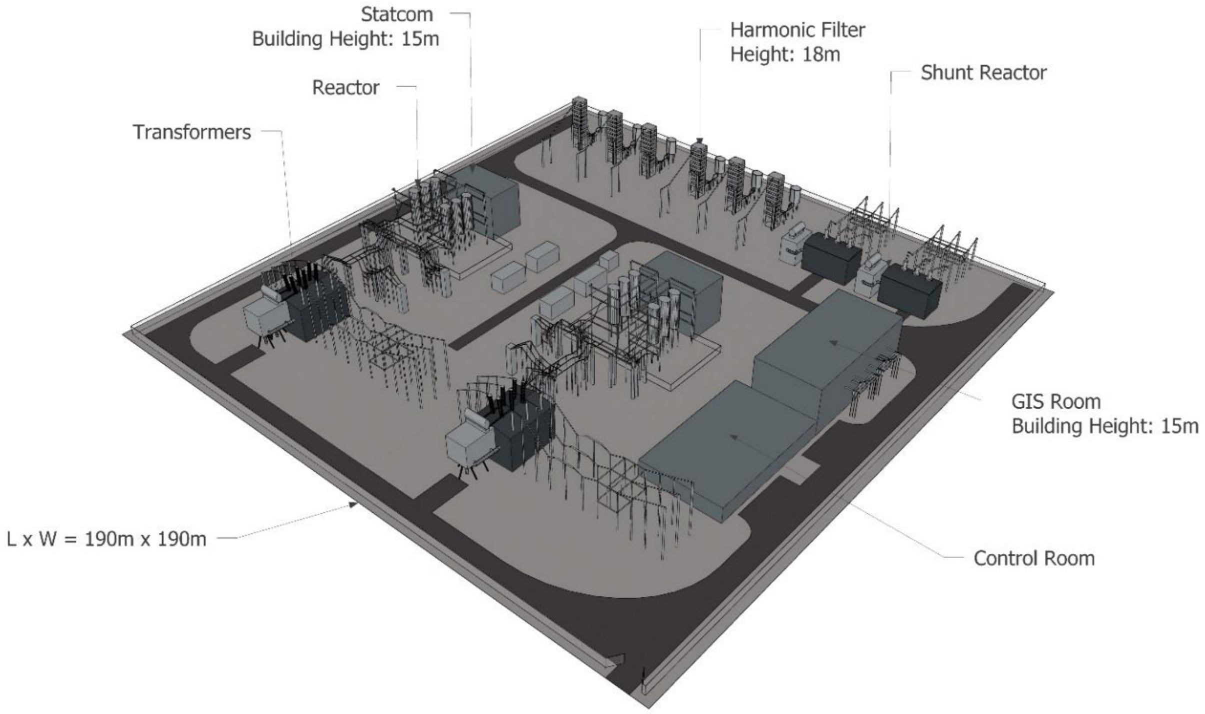


Plate 6.15 Rochdale Envelope 3D model of East Anglia ONE North onshore substation

6.7.8 Onshore Substation: Construction

6.7.8.1 Site Establishment and Laydown Area

398. During construction of the onshore substation, site establishment and laydown areas would be required. The total area of this would be up to a maximum of 190m x 90m. In addition, the East Anglia ONE North onshore substation footprint could be used as a site establishment and laydown area. The following would be required during the construction works:

- Temporary construction management offices;
- Canteen;
- Washroom facilities;
- Car parking;
- Wheel washing facility; and
- Workshops.

6.7.8.2 Pre-Construction Activities

399. Prior to the commencement of the East Anglia ONE North onshore substation works, a number of pre-construction surveys and studies would be undertaken to inform the design teams when developing the final design including:

- Archaeological pre-construction work;
- Ecological pre-construction surveys;
- Geotechnical investigations; and
- Drainage study.

6.7.8.3 Landscaping and Screening

400. The East Anglia ONE North onshore substation site benefits from some substantial existing hedgerows and woodland blocks within the local area. However, the Applicant has committed to additional planting and landscape bunding to further screen the East Anglia ONE North onshore substation. The location of this proposed additional planting is provided in ***Figure 29.11*** within ***Chapter 29 Landscape and Visual Impact***, which also includes further information on the proposed screening.

401. The mitigation planting would be designed to comprise a mix of faster growing ‘nurse’ species and slower growing ‘core’ species. The core species would comprise a mix of preferred native, canopy species that would outlive the nurse species and characterise the woodland structure over the longer term. It is anticipated that the growth rate of these species would be on average 300mm per annum.

402. In locations where it is possible to achieve advanced planting, this will be undertaken in consultation with the local community to allow growth prior to completion of construction and commencement of operation.

6.7.8.4 Temporary Fencing

403. Temporary fences would be erected along the boundaries of the East Anglia ONE North onshore substation site for the duration of the construction period.

6.7.8.5 Substation Construction Access Haul Road

404. A temporary haul road would be installed along the onshore cable route between access points onto the local road network to facilitate construction access to the substation. This would run from Access ID 9 at Snape Road, across Crossing ID 10 and Crossing ID 11 at Grove Road and proceed into the onshore substation and National Grid substation location (see ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***). The substation construction access road would be 9m wide to facilitate two-lane construction traffic.

405. Temporary haul road construction would most likely involve the placement of a suitable imported material (such as aggregate onto a geotextile base and / or use of temporary mats).

6.7.8.6 Grading and Earthworks

406. The enabling works that are typically required to facilitate the construction of a substation facility can vary greatly. The main factors to consider are the overall topography of the site and the previous use of the land in question.

407. The location for the onshore substation and National Grid substation is agricultural land.

408. The entire area would be stripped of all organic matter and loose rocks. Any waste material encountered would be removed as required by the environmental and geotechnical investigations. Once the surface had been cleared, the grading operations would begin.

409. The preference would be to retain materials on site for use as engineering fill or landscaping depending on the material properties.

410. If it were to prove impossible or impractical to balance the earthwork quantities, it would be necessary to either export excess soil or import new fill soil. Any soil exported would be disposed of at a licensed disposal site. Excavations of foundations and trenches would commence following the completion of grading.

6.7.8.7 Surface Water Drainage

411. Impermeable areas, for instance the control and ancillary buildings within the site, would require permanent surface drainage. Discharges would be routed to a

suitable watercourse or soakaway in the absence of a local authority sewer (dependant on ground permeability).

412. Surface water drainage requirements would be dictated by the final drainage study and would be designed to meet the requirements of the NPPF[3] with run-off limited where feasible, through the use of infiltration techniques which can be accommodated within the area of development.

413. High level studies have indicated that a Sustainable Drainage System (SuDS) pond with volume 6,600m^3 (on the conservative assumption of requirement for 1 in 200 year rainfall event including 20% allowance for climate change) should be employed to allow a sufficient attenuation to greenfield runoff rates into the closest watercourse or sewer connection. An indicative onshore substation SuDS pond size and location is illustrated on ***Figure 6.7i***. The full specification for the SuDS pond and drainage strategy would be addressed as part of detailed design post-consent.

414. Outside of the impermeable areas the site finishes would consist of stone chippings over an appropriate thickness of sub-base to provide an access surface for plant maintenance.

6.7.8.8 Foul Drainage

415. Foul drainage would be collected in either of the following ways:

- Mains connection discharged to Local Authority sewer system, if available; or
- Septic tank located within the onshore substation location boundary.

416. The preferred method for controlling foul waste would be determined during detailed design and will depend upon the availability and cost of a mains connection and the number of visiting hours staff would attend site.

6.7.8.9 Substation Operational Access Road

417. Road modifications would be required to facilitate the safe ingress and egress from the public highway to the East Anglia ONE North onshore substation during operation. A substation operational access road will be constructed from Access ID 12 in ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***. The permanent operational access road would typically be 8m in width, and approximately 1,600m in length.

418. Traffic and transport assessments have identified a location for where this permanent access may be required, and further assessment will be undertaken

[3] Limit post development off site run-off to the existing greenfield rate and providing sufficient on site attenuation for rainfall events up to 1 in 100 year rainfall event, plus a 30% allowance for climate change over the lifetime of the development.

post consent based on the final design of the project to finalise the exact route of the substation operational access road. An Outline Access Management Plan will be submitted with the DCO application.

419. The substation operational access road will be used for all operational vehicle access, including Abnormal Indivisible Load access (during construction and operation), and potentially (once available) for construction personnel movements. HGVs will not use the substation operational access road during construction.

6.7.8.10 Construction: Foundations

420. The foundations would either be ground-bearing or piled based on the prevailing ground conditions.

421. The construction of the ground bearing foundations would take place in the following general sequence:

- Excavation as appropriate;
- Installation of blinding (concrete);
- Construction and installation of timber formwork and supports;
- Installation of steel cages (rebar);
- Placement of structural concrete; and
- Curing and finishing.

422. The construction of pile foundations would take place in the following general sequence:

- Excavation as appropriate;
- Construction of piling platform and piling;
- Installation of blinding (concrete);
- Construction and installation of pilecap formwork and supports;
- Installation of pilecap steel cages (rebar);
- Placement of pilecap structural concrete; and
- Curing and finishing.

6.7.8.11 Construction: Buildings

423. The proposed building substructures are typically predominantly composed of steel and cladding materials. The structural steelwork would be fabricated and prepared off site and delivered to site for erection activities. The steelwork would be erected with the use of cranes.

424. Cladding panels (typically composite) would also be delivered to site ready to erect and be fixed to the steelwork. A variety of means would be used to install the cladding, depending on the area being accessed. The control building would include the construction of brick/blockwork partitions and would include a number of follow-on trades for plumbing, plastering, and low voltage mechanical/electrical installations.

6.7.8.12 Construction: Installation works

425. For the installation and commissioning phases of the project a variety of specialist activities would be required associated with construction of the buildings within the East Anglia ONE North onshore substation footprint (e.g. GIS building, statcoms building and control building). This will also include installation of the transformers.

426. These items of plant would be delivered sealed and would be particularly bulky, heavy items. Due to their size and weight they would be delivered via specialist means and offloaded with the use of a mobile gantry crane.

427. The majority of the remaining HVAC equipment would be erected with the use of small mobile plant and lifting apparatus.

6.7.8.13 Construction: Traffic and plant

428. A full Construction Traffic Management Plan would be developed prior to construction. This would detail temporary road closures, diversions and/or other local traffic management that may be necessary. An outline Construction Traffic Management Plan will be submitted with the DCO application.

429. ***Section 6.7.3*** outlines the proposed approach to construction traffic across the whole onshore cable route, including discussion of CCSs. It is proposed that construction traffic for the onshore substation and the National Grid substation would be routed to a dedicated substation CCS using key delivery routes identified for the East Anglia ONE North substation and National Grid substation construction which are shared with the onshore cable route construction works. These are shown in ***Figure 26.7*** within ***Chapter 26 Traffic and Transport***.

430. ***Table 6.27*** summarises vehicle types associated with site deliveries and gives provisional associated vehicle movement numbers for the construction phase.

Table 6.27 Indicative Site Delivery Vehicle Movements for the Onshore Substation

Activity	Vehicle type	Typical movements
Site clearance	20t lorry	650
Concrete supply	Concrete wagon	2,750
General materials deliveries	HGV	6,000

Activity	Vehicle type	Typical movements
General materials deliveries	7.5t van	100
Transformer deliveries	Abnormal load	2

431. Construction will include a number of key stages, including earthworks, foundations, superstructure and equipment installation. The realistic worst case for construction assumes several activities taking place at the same time. This is expected to occur during the early stages when earthworks are being undertaken while foundations are also being constructed and other materials are being delivered.

6.7.8.14 Lighting

432. As a worst case scenario, it has been assumed that some periods of 24 hour construction may be required, for which task related flood lighting may be necessary.

433. Operational lighting requirements at the East Anglia ONE North onshore substation site may entail:

- Security lighting around perimeter fence of compound, to allow CCTV coverage;
- Car park lighting – as per standard car park lighting, possibly motion sensitive; and
- Repair / maintenance – task related flood lighting may be necessary.

434. No additional lighting is proposed along Grove Road or along the additional access roads within the East Anglia ONE North substation location.

6.7.8.15 Workforce

435. The construction workforce would consist primarily of specialist workers who travel to work on similar projects throughout the UK and abroad. To supplement this, local workers would be used where possible, subject to required skills being available.

6.7.9 National Grid Infrastructure

436. A National Grid substation is required to connect the East Anglia ONE North onshore substation to the overhead lines. This National Grid substation will accommodate circuit breakers and associated busbar (metal bar that conducts electricity within a substation) structures which allow connection onto the existing 400kV overhead line for generation to be transmitted onto the wider National Grid system. In addition to the National Grid substation itself, modifications to the existing overhead line structures adjacent to the National Grid substation would

be required to bring the overhead lines to ground within new cable sealing ends (Each overhead line tower carries two 400kV circuits. In this arrangement, circuits are connected to the substation busbars via underground cables from cable sealing end compounds and overhead line connections depending on the final design).

6.7.9.1 General Specification

437. The National Grid substation would be located to the immediate north west of the East Anglia ONE North substation at the Grove Wood, Friston site; and running parallel to the existing overhead lines that connect Sizewell and Bramford.

438. The National Grid substation would be located within a single compound, with two potential substation arrangements – AIS or GIS. The maximum footprint dimensions of a National Grid AIS substation are up to a maximum of 140m (width) x 325m (length). The maximum footprint dimensions of a National Grid GIS substation are up to a maximum of 140m (width) x 120m (length)

439. The maximum height of the outdoor equipment to connect the National Grid substation (AIS or GIS) to the overhead lines is estimated to be 16m. Maximum building height for a National Grid AIS substation is 13m, and maximum building height for a National Grid GIS substation is 16m.

440. Up to four cable sealing ends, which comprise a small fenced electrical compound with electrical equipment and an overhead line gantry, will be required to allow connection of the overhead lines to the new substation.

441. The National Grid substation is to be constructed to facilitate the East Anglia ONE North and East Anglia TWO projects only, including modification to the existing overhead lines.

442. One additional overhead line pylon will be required to separate the overhead line circuits to facilitate the connection to the overhead lines. This would be located to the north west of the National Grid substation with a comparable height to the existing overhead line pylons.

443. All other overhead line pylons in the vicinity of the National Grid substation within the National Grid Overhead Line Realignment Works Area (as per ***Figure 6.2***) may be subject to replacement or upgrade works to facilitate the connection to the network. Replacement or upgrade works to overhead line pylons will be of a comparable height to the existing overhead line pylons.

444. The National Grid substation and overhead line modification works will be conducted within the area identified within ***Figure 6.2***.

445. ***Table 6.28*** and ***Table 6.29*** summarise the National Grid substation key parameter options for AIS and GIS:

Table 6.28 National Grid AIS Substation Key Parameters Summary

Element	Maximum	Comments
Length of site (m)	325	
Width of site (m)	140	
Tallest structure (m)	16m	Outdoor landing gantries
Tallest building (m)	13m	AIS building
Tallest new pylon (m)	Comparable to existing	One new pylon, plus upgrade / replacement of existing pylons

Table 6.29 National Grid GIS Substation Key Parameters Summary

Element	Maximum	Comments
Length of site (m)	120	
Width of site (m)	140	
Tallest structure (m)	16m	Outdoor landing gantries
Tallest building (m)	16m	GIS building
Tallest new pylon (m)	Comparable to existing	One new pylon, plus upgrade / replacement of existing pylons

6.7.10 National Grid Substation Construction

6.7.10.1 National Grid Construction Consolidation Site (CCS)

446. During construction of the National Grid substation for East Anglia ONE North, a CCS will be established to support the works. Given project duration, the CCS will likely be tarmacked with concrete hard standing (2 x CCS dimensions of 125m x 315m, plus the permanent footprint of 140m x 325m to be used as a CCS during construction) for heavier plant and equipment. Access to the Snape Road will be provided utilising the substation construction access road (running south of Grove Wood and parallel to the proposed cable route haul road) to permit safe delivery of plant and equipment required for construction, with a ‘no right turn’ traffic management scheme employed for safety.

447. The CCS will accommodate construction management offices, welfare facilities, car parking, workshops and storage areas. Water, sewerage and electricity services would be required at the site and supplied either via mains connection or mobile supplies such as bowsers, septic tanks and generators.

448. The location of the National Grid substation CCS will be sited within the zone identified in ***Figure 6.2***, in close proximity to the proposed National Grid substation site with due consideration for avoiding existing watercourses, hedgerows and other known infrastructure / constraints to minimise impacts. The overhead line CCS will be identified during detailed design, but will be within the National Grid Overhead Line Realignment Works Area (as per ***Figure 6.2***).

6.7.10.2 Pre-construction works

449. Prior to the construction works beginning, a number of surveys and studies would be undertaken to inform the final detailed design including ecological surveys, archaeological surveys, geotechnical investigations and mitigation requirements such as landscaping and drainage assessments (see ***Chapter 22 Onshore Ecology*** and ***Chapter 24 Archaeology and Cultural Heritage*** for further information).

450. Surface water drainage requirements would be dictated by the final drainage study and would be designed to meet the requirements of the NPPF[4]. The SuDS philosophy would be employed to limit run-off, where feasible, through the use of infiltration techniques which can be accommodated within the Proposed Development Area. Allowance for a SuDS pond has been included to accommodate additional impermeable ground associated with the National Grid substation. An indicative National Grid SuDS pond size and location is illustrated on ***Figure 6.7i***. The full specification for the SuDS pond and drainage strategy would be addressed as part of detailed design post-consent.

451. Foul drainage would be collected through a mains connection to existing local authority sewer system if available or septic tank located within the development boundary. The specific approach would be determined during detailed design with consideration for the availability of mains connection and the number of visiting hours for site attendees during operation.

452. The National Grid substation would be enclosed by a temporary perimeter fence for the duration of the construction period with a permanent fence installed as part of the construction works.

6.7.10.3 Construction

453. The site would be stripped and graded for the substation and cable sealing ends. Stripped material would be reused on site where possible as part of bunding and shielding as allowed for in the detailed design. Any excess material would be

[4] Limit post development off site run-off to the existing greenfield rate and providing sufficient on site attenuation for rainfall events up to 1 in 100 year rainfall event, plus a 30% allowance for climate change over the lifetime of the development.

disposed of at a licenced disposal site. Excavations and laying of foundations, trenches and drainage would commence after grading is complete.

454. The design and construction of foundations at the National Grid substation will be subject to the outcome of geo-technical site investigations, post consent. It is possible that some piled foundations will be required. Upon completion of the foundations, the specialist electrical equipment would then be delivered to site, installed and commissioned.

455. For the overhead line modifications, temporary pylons would be constructed in close proximity to the existing pylons and the existing circuits transferred over to the temporary pylons (within the area identified in ***Figure 6.2***) to allow for construction activities. Existing pylon(s) would be reinforced in-site where possible, or removed and replaced with upgraded pylon(s). An additional one new pylon would also be required in close proximity to existing overhead pylons. The circuits would then be transferred from the temporary pylons. The temporary pylons and foundations would then be removed. The pylon foundations may be piled or excavated and cast, dependent on the ground conditions and structural requirements. The orientation and design of the replacement pylons would be selected to allow for the connection via cable sealing ends. Underground cables would be installed between the cable sealing ends and the National Grid substation.

6.7.11 Onshore Substation and National Grid Substation: Operation

456. The maintenance regime for the onshore substation would depend on the design of the adopted National Grid substation. The design would incorporate extensive redundancies for cooling systems, duplicated control systems and power. This would allow most of the maintenance work to be done with no interruption to operation. Within the onshore substation site, there will be an area for storage of key components.

457. It is anticipated that the onshore substation would not be staffed. There would be the occasional maintenance visits. Within the onshore substation location, there would be an area for storage of key components. Storage for cable repairs may be at the O&M port or strategic location near the onshore cable route.

458. The National Grid substation would be unmanned. Maintenance of the substation would be undertaken approximately every three years, involving electrical isolation of equipment before it is worked on. Visual checks would normally be undertaken on a weekly / monthly inspection visit to the site. If the substation requires refurbishment or replacement works, vehicles would be used to carry workers in and out of the site and suitable vehicles would be used to bring new materials and equipment to the site and to remove old equipment. During operation, the National Grid substation would not normally be illuminated.

However, lighting would be used when conducting inspection and maintenance activities

459. Details of the operational noise levels are provided in ***Chapter 25 Noise and Vibration***. A standby generator will be at the site for emergency use only.

6.7.12 Onshore Substation and National Grid Substation: Decommissioning

460. No decision has been made regarding the final decommissioning policy for the onshore substation and National Grid Substation, as it is recognised that industry best practice, rules and legislation change over time.

461. The onshore substation and National Grid Substation and equipment could be removed and the components reused or recycled. The foundations would be removed to below ground level and the ground covered in topsoil and re-vegetated to return the site to its initial state or reused for other future developments.

462. The decommissioning methodology cannot be finalised until immediately prior to decommissioning, but would be in line with relevant policy at that time.

6.8 Offshore Programme

463. It is anticipated that the offshore construction works would be completed in approximately 27 months. The time periods of specific offshore activities would vary and would be encompassed within this 27 month period. Where appropriate, maximum durations for activities (e.g. piling) have been outlined as worst case scenarios in the relevant technical chapters.

6.9 Onshore Programme

464. The assessments in ***chapters 18-27*** and ***29-30*** are based on an initial high level indicative programme which was developed for the PEIR. This is presented below. The onshore programme does not include for pre-construction works included in the durations presented below.

465. Construction activities would normally be conducted during Monday to Saturday working hours of 7am to 7pm. Working hours are not proposed for Sundays or Bank Holidays. Evening or weekend working may be required to maintain programme progress and for specific time critical activities (e.g. HDD works will require 24 hour working).

6.9.1 Landfall

466. Construction, site clearance and full reinstatement of the landfall would be approximately 20 months.

6.9.2 Onshore Cable Route

467. Construction, site clearance and full reinstatement of the onshore cable route would be approximately 24 months.

6.9.3 East Anglia ONE North Onshore Substation

468. Construction, site clearance and full reinstatement (including landscape bunding and planting) of the East Anglia ONE North onshore substation would be approximately 30 months.

6.9.4 National Grid Substation

469. Construction, site clearance and full reinstatement (including landscape bunding and planting) of the National Grid substation is expected to be approximately 48 months.

6.9.5 National Grid Overhead Line Realignment Works

470. Construction, site clearance and full reinstatement of the National Grid overhead line realignment works is expected to be undertaken within a period of 36 months. However, the timing of the overhead line works will be subject to securing the necessary circuit outages.

6.9.6 Refined Programme

471. Since the initial indicative programme was developed, further detailed work has been undertaken on the project description which provides greater granularity on the likely durations of activities. These are presented below but have not been incorporated into the assessments at this time.

- 1-year pre-construction work;
- 2-year substation enabling and construction works;
- 1-year onshore cable route construction;
- 9 months landfall construction works;
- 1-year commissioning and reinstatement;
- 4-year National Grid substation enabling and construction works (dependent on timing of works being subject to securing the necessary circuit outages); and
- 3-year National Grid overhead line realignment works (dependent on timing of works being subject to securing the necessary circuit outages).

472. The assessments provided in the ES will be revised where required to take account of programme refinements.

6.10 Indicative Construction and Operation Plans

473. An indicative set of proposed East Anglia ONE North project and proposed East Anglia TWO project construction plans are contained within ***Figure 6.6a-j***. This

indicative set of plans is for illustrative purposes only and provides an early indication of the layout of the construction phase for the landfall, onshore cable route, onshore substation and National Grid infrastructure.

474. An indicative set of proposed East Anglia ONE North project and proposed East Anglia TWO project operational plans are contained within ***Figure 6.7a-j***. This indicative set of plans is for illustrative purposes only and provides an early indication of the layout of the operational phase for the landfall, onshore cable route, onshore substation and National Grid infrastructure.

475. Details contained within these plans are subject to ongoing refinement through consultation and PEIR assessment outputs, including ongoing detailed design. Indicative plans will be amended for submission of the DCO application. The full specification for the construction and operation phases will be addressed as part of detailed design post-consent.

6.11 East Anglia ONE North and East Anglia TWO Cumulative Project Descriptions

476. As detailed in previous sections, the proposed East Anglia TWO project is also in the pre-application phase. The proposed East Anglia TWO project will have a separate DCO application but is working to the same programme of submission as the proposed East Anglia ONE North project. The two projects will share the same landfall location, onshore cable route, National Grid infrastructure; and the two onshore substations will be co-located.

477. The proposed East Anglia ONE North project CIA will therefore initially consider the cumulative impact with the proposed East Anglia TWO project against two different construction scenarios (i.e. construction of the two projects simultaneously and sequentially). The realistic worst case scenario of each impact is then carried through to the main body of the CIA assessment which considers other developments which are in close proximity to the proposed East Anglia TWO project.

478. The two construction scenarios assessed are:

- Scenario 1 - the proposed East Anglia ONE North project and proposed East Anglia TWO project are built simultaneously; and
- Scenario 2 - the proposed East Anglia ONE North project and the proposed East Anglia TWO project are built sequentially.

479. Under Scenario 2, it is intended that the construction of the proposed East Anglia TWO project will be progressed prior to commencing construction of the proposed East Anglia ONE North project.

480. Scenario 2 assumes that when permission is granted, the proposed East Anglia TWO project will be constructed as soon as permission is granted. The proposed East Anglia ONE North project will leave the largest possible gap (between the reinstatement of the proposed East Anglia TWO project and start of construction for the proposed East Anglia ONE North project) to begin construction within the consent period.

481. ***Appendix 6.1*** compares the East Anglia ONE North project in isolation (as described in ***section 6.7***) with construction Scenario 1 and construction Scenario 2.

6.12 Response to Potential Major Accidents and Disasters

482. The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations 2017) require significant risks to the receiving communities and environment, for example through major accidents or disasters, to be considered. Similarly, significant effects arising from the vulnerability of the proposed development to major accidents or disasters should be considered. Relevant risks are covered in the topic chapters within this PEIR.

483. A major accident, as defined in the Control of Major Accident Hazards (COMAH) Regulations 2015 (as amended), means "an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment to which these Regulations apply, and leading to serious danger to human health or the environment (whether immediate or delayed) inside or outside the establishment, and involving one or more dangerous substances"

484. Offshore wind developments have an intrinsically low risk of causing major accidents. The wind turbines, blades, towers and foundation bases of offshore windfarms have an excellent safety record with a very low failure rate and are positioned many kilometres offshore away from populated areas and the public. On the rare occasion that offshore turbine blades have been lost into the sea or damage has been caused to a turbine by a fire within the nacelle, this has resulted without injury. The performance of each turbine is constantly monitored through the SCADA system sending performance data through to a central, partly automated monitoring and control centre. As a result, a problem can be quickly detected and pre-prepared safety management action plans rapidly enacted.

485. Regarding emergency response procedures whilst conducting operations within the Sizewell Emergency Response Zone of Influence, the Applicant will incorporate EDF Energy's Emergency Response Plan procedures within the Applicant's emergency response plan for works within the zone. The Applicant will liaise with EDF Energy in this regard prior to the commencement of construction.

486. Whilst exposed power cables on the seabed can pose a snagging risk to shipping and fishing vessels, the projects export and array cables will be buried where possible to protect the cables and remove the snagging risk. This is discussed in detail in ***Chapter 14 Shipping and Navigation***, which also discusses the risk that the increased vessel movement to and from the site may pose to navigational safety during construction and operational phases.

487. The buried cables onshore and offshore pose very little risk to the public as the system is designed to detect faults and 'trip out' the circuits automatically should any failure in insulation along the cable be detected.

488. The risk of substation fires is historically low however substation fires can impact the supply of electricity and create a localised fire hazard. The highest appropriate levels of fire protection and resilience will be specified for the onshore project substation to minimise fire risks. The onshore substation is located sufficiently distant from populated areas to further minimise the risk of fire hazard.

489. The lubricants, fuel and cleaning equipment required within the project will be stored in suitable facilities designed to the relevant regulations and policy design guidance.

490. The offshore wind industry strives for the highest possible health and safety standards across the supply chain. However there have been incidents including a small number of worker fatalities during the construction and operation of offshore windfarms. Risks to the public onshore and other sea users offshore during construction are minimised through the use of controlled construction sites onshore and vessel safety zones offshore.

491. Safety zones are temporary exclusions enacted during construction, allowing the Applicant and its contractors to control vessel movement to enable safe construction works to proceed.

492. Onshore, controlled or closed construction sites will be operated where construction works are undertaken in sections where access is strictly controlled during periods when the works are ongoing.

493. The Applicant recognises the importance of the highest performance levels of health and safety to be incorporated into the project. There is a commitment to adhere to a high level of process safety, from design to operations and for all staff, contractors and suppliers to have a high level of safety awareness and knowledge of safety and safe behaviour. The Applicant will enact a Code of Conduct for suppliers, contractors and subcontractors. They must all comply with the Code as well as health and safety legislation. The Applicant will ensure that employees have undergone the necessary health and safety training.

494. With a commitment to the highest health and safety standards in design and working practises enacted, none of the anticipated construction works or operational procedures is expected to pose an appreciable risk of major accidents or disasters.

495. In conclusion, the risk of 'major accidents and/or disasters' occurring associated with any aspect of the project, during the construction, operation and decommissioning phases is negligible.

6.13 Summary

496. As discussed in ***section 6.1*** of this chapter, each of the specialist chapters within this ES have identified and tabulated the relevant worst case assumptions from the detail provided within this chapter, and used this as a basis for their technical assessments.

6.14 References

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