AQUIND Limited

AQUIND INTERCONNECTOR

Environmental Statement – Volume 1 – Chapter 3 Description of the Proposed Development

The Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 – Regulation 5(2)(a)

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

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3. DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1. INTRODUCTION

3.1.1.1. This chapter provides a description of the Proposed Development for the purposes of undertaking an environmental impact assessment (‘EIA’) in relation to it, the findings of which are set out in chapters 6 – 30 of Volume 1 to this Environmental Statement (‘ES’) (document references 6.1.3 – 6.1.30).

3.1.1.2. The Proposed Development is shown on the Works Plans (Document Reference 2.4) that accompany the application for development consent for the Proposed Development (the 'Application') and described in Schedule 1 to the draft Development Consent Order (the 'Order') (Document Reference 3.1).

3.1.1.3. This chapter describes the physical characteristics of the Proposed Development, together with its location; land use requirements; proposed access arrangements; landscaping strategy and the maximum parameter envelope within which the Proposed Development will be carried out.

3.1.1.4. The description of the Proposed Development provided in this chapter represents the design envelope within which it will be carried out, taking into account the parameter based approach that is followed in relation to the Converter Station and the limits of deviation within which the High Voltage Direct Current (‘HVDC’) Cable may be laid both onshore and in the marine environment.

3.1.1.5. The final built form and layout of the Proposed Development, as well as the installation/construction methods to be utilised, will be determined by the chosen contractor(s) for the Proposed Development, however all works of the development will be required to be undertaken within the assessed parameters for the Proposed Development. With this in mind, the EIA undertaken and reported in this ES represents a 'worst-case', ensuring a robust assessment of the likely significant effects.

3.2. OVERVIEW OF THE PROJECT

3.2.1.1. The Applicant is proposing to construct and operate an electricity interconnector between France and the UK known as AQUIND Interconnector (‘the Project’).

3.2.1.2. The Project comprises a new marine and onshore HVDC cable transmission link between Normandy in France and Eastney, Hampshire, Converter Stations in both England and France and infrastructure necessary to facilitate the import and export of electricity between the High Voltage Alternating Current (‘HVAC’) electricity transmission networks of both countries as well as Fibre Optic Cables (‘FOC’) and associated infrastructure necessary for their operation.

3.2.1.3. The Project will be approximately 238 km in length and comprise the following Marine and Onshore components in France and UK:

- HVDC Cables (Marine);
- HVDC Cables (Onshore);
- Converter Stations;
- High Voltage Alternating Current (‘HVAC’) Cables (Onshore)
- Fibre Optic Cables (Marine and Onshore); and
- Associated Infrastructure.

3.2.1.4. The French and UK elements of the Project require different consents and licences within their respective jurisdictions. It should be noted that a separate environmental impact assessment of the French elements of the Project has been undertaken to inform the French consenting process.

3.3. OVERVIEW OF THE PROPOSED DEVELOPMENT

3.3.1.1. The Proposed Development comprises the elements of the Project in the UK and the UK Marine Area for which development consent is sought by the Application. The Proposed Development is broadly comprised of the Marine Components and the Onshore Components.

3.3.1.2. In light of this, this Chapter describes first the Marine Components of the Proposed Development (at section 3.5) and following this, the Onshore Components of the Proposed Development (at section 3.6).

3.3.1.3. In relation to both the Marine and the Onshore Components this Chapter describes the activities and programme proposed for the construction, operation, maintenance and decommissioning of the Proposed Development (though development consent for decommissioning is not sought as part of the application).

3.3.1.4. Due to the nature of the Proposed Development, being located in the UK and in the UK Marine Area, and the EIA that is required in relation to each, the Marine and Onshore Components are described separately (with the cumulative effects of both considered at chapter 29 of this ES).

3.3.1.5. The use of the term 'Proposed Development' will differ throughout the ES depending on whether it is being used in reference to the Onshore or Marine Components of the Proposed Development.

3.3.1.6. The Marine Components of the Proposed Development are all of that part within the UK Marine Area, being from the Mean High Water Spring mark ('MHWS') out to the limit of the UK/France Exclusive Economic Zone ('EEZ') boundary line (Plate 3.1)[1].

3.3.1.7. The Onshore Components of the Proposed Development are all elements of the Proposed Development above the Mean Low Water Spring ('MLWS') mark (Plate 3.1).

[1] In accordance with Section 42 of the Marine and Coastal Access Act 2009

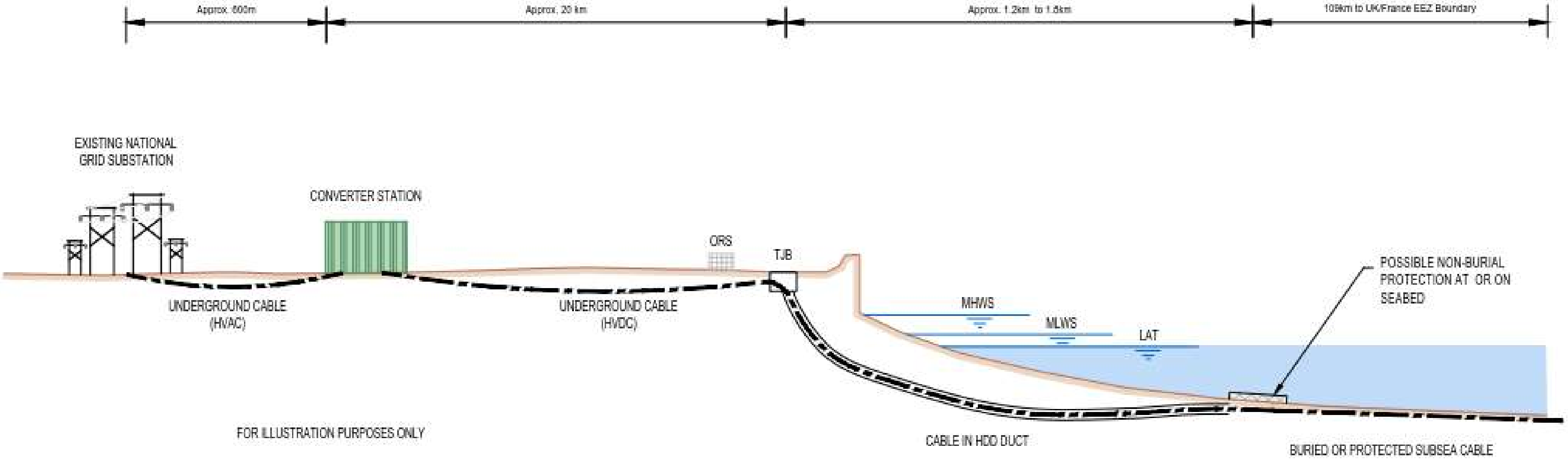

Plate 3.1 - Aquind Interconnector Arrangement - UK Side.

3.3.1.8. In broad terms, the Proposed Development will comprise the following components:

- The Marine Cable consisting of two HVDC Circuits from the boundary of the UK EEZ to MHWS at Eastney in Portsmouth;
- Jointing of the HVDC Cables at the Landfall;
- The Onshore Cable consisting of two HVDC Circuits from MLWS at Eastney in Portsmouth to the Converter Station;
- The Converter Station Area, including the Converter Station and associated equipment, the Telecommunications Buildings and their compound, the Work Compound and Laydown Area, the Access Road, and other associated infrastructure;
- The HVAC Cables, and associated infrastructure connecting the Converter Station to the National Electricity Transmission System at Lovedean Substation and;
- The Fibre Optic Cables installed together with each of the HVDC and HVAC Circuits and associated infrastructure.

3.3.1.9. As outlined above the Proposed Development is to be carried out in part within a maximum parameter design envelope (the Converter Station Area and Optical Regeneration Stations) and in part within limits of deviation (the HVAC Cable, the Onshore Cable and the Marine Cable). General information regarding the approach taken to the design of the Proposed Development is provided below, with the design approach for each relevant part of the Proposed Development explained when that part of the Proposed Development is explained in detail.

3.4. APPROACH TO DESIGN PARAMETERS

3.4.1. DEVELOPMENT ENVELOPE

3.4.1.1. The Proposed Development envelope consists of the Order Limits, identified on the Works Plans (document reference 2.4) within which the Proposed Development is to be located.

3.4.1.2. A maximum parameter envelope and design principles are utilised for a number of key project components. This is to ensure a robust assessment can be carried out taking into account the maximum built form of elements of the Proposed Development, whilst ensuring sufficient design flexibility for the chosen contractor to optimise the final design in accordance with those maximum parameters and design principles. Further detail on the project design flexibility is contained within Appendix 3.1. The approval of the final designs is to be controlled via requirements, contained at schedule 2 to the Order (Document Reference 3.1).

3.4.1.3. In respect of both the Onshore Cables and the Marine Cables, the Order Limits identify the extent of the limits of deviation within which the respective HVDC Circuits may be installed.

3.4.1.4. In respect of the Onshore Cables, this approach has been taken to ensure there is sufficient flexibility provided for the installation to be carried out around other utilities and features, whilst ensuring from the outset it is clearly known what is the maximum area that may be affected by this element of the Proposed Development (for further details see Appendix 3.1).

3.4.1.5. In respect of the Marine Cables, this approach is followed to allow for the micro-routing of the cables within the identified corridor taking into account future detailed pre-installation surveys which are to be carried out in accordance with the Deemed Marine Licence which forms part of the Order.

3.4.1.6. In certain areas, where Horizontal Direction Drilling ('HDD') and other Trenchless techniques are to be used to install the Onshore Cables or where the Onshore Cables connect to the Marine Cables, a wider limit of deviation is provided to ensure the full extent of the area beneath the surface where the Cables may be located is identified.

3.4.1.7. In addition, the final burial depth of the respective cables will be confirmed when the final design is produced by the chosen contractor. Noting this, the EIA has been carried out on the basis of worst-case assumptions regarding the proposed cable burial along the Proposed Development (see Appendix 3.2 for details of the Marine Worst Case Design Parameters).

3.4.1.8. The information presented within this chapter explains the Proposed Development and the range of design parameters upon which the technical assessment chapters are based.

3.5. PROPOSED DEVELOPMENT – MARINE

3.5.1.1. The description of the Proposed Development within the UK Marine Area is structured as follows:

- Marine Parameters
- Marine Cable System and Design
- Marine Survey
- Route Preparation for Marine Cable
- Marine Cable Installation
- Landfall Installation (Marine)
- Marine Cable Installation Vessels
- Marine Cable Operation and Maintenance
- Decommissioning of Marine Cables

3.5.2. MARINE PARAMETERS

Marine Cable Corridor

3.5.2.1. The Marine Cable Corridor runs from the UK/France EEZ boundary to MHWS below the Landfall, where the Marine Cables are jointed to the Onshore Cables.

3.5.2.2. The Landfall is located at Eastney, to the south-east of Portsmouth, Hampshire and is shown in Figure 3.3.

3.5.2.3. The Marine Cable Corridor is shown on the Works Plans (Document Reference 2.4) and is also identified at Figure 3.1 to this ES. The total length of the Marine Cable Corridor in UK waters is approximately 109 km from the Landfall at Eastney to the UK/France EEZ boundary line.

3.5.2.4. Kilometre Points ('KP') have been used to denote positions along the centre line of the Marine Cable Corridor, though this centre line does not represent a preferred micro-routing for the Marine Cables.

3.5.2.5. The Inshore section of the Marine Cable Corridor refers to the section of the Marine Cable Corridor that runs from the Landfall out to the 12 nautical mile ('nmi') limit of UK Territorial Waters (i.e. approximately KP 0.027 - KP 45). The Offshore section of the Marine Cable Corridor refers to the section of the Marine Cable Corridor from the 12 nmi limit out to UK/France EEZ boundary line (KP 45 to KP 109) (see Table 3.1).

Table 3.1 KP of key features along the Marine Cable Corridor

KP	Key Feature
0.027	Start of the Marine Cable Corridor at MHWS
0.050	Start of survey data
0.076	MLWS
8.600	10 m water depth
45.116	12 nmi boundary
109.107	UK/France EEZ Boundary Line

Definition of Terms

3.5.2.6. The following terms are used in defining the Marine Cable Corridor:

- Survey Centreline ('SCL'): the centreline of the Marine Cable Corridor which is also the centreline of the as-surveyed marine geophysical and geotechnical survey corridor;
- Marine Cable Corridor: the corridor encompassing the marine geophysical and geotechnical survey, centred on the SCL. This is 500 m wide from KP 0 to KP 8.6 and 520 m wide from KP 8.6 to the UK/France EEZ boundary line. The Marine Cable Corridor is also extended to include a 1,500 m diameter circular area centred on the Atlantic Crossing 1 optical submarine telecommunications cable at approximately KP 72.5, to provide sufficient design flexibility within which to construct the required cable crossing at this location; and
- Marine Cable Route: this will be the final route for the Marine Cables that lie within the Marine Cable Corridor, comprising two bundled HVDC Circuits typically 50 m apart.

3.5.2.7. Positional references to the Marine Cable Corridor in this ES are in relation to KP along the SCL. The start of the Marine Cable Corridor for the purposes of the Proposed Development begins at KP 0.027 (at MHWS) of the as-surveyed geophysical and geotechnical survey corridor. The final Marine Cable Route will diverge from the SCL but will be within the maximum extent of the Marine Cable Corridor within the UK Marine Area.

3.5.3. MARINE CABLE SYSTEM AND DESIGN

3.5.3.1. The Marine Cable Route will consist of four 320 kV HVDC cables, installed for the majority of the route as two HVDC Circuits. There is the potential that the Marine Cables will be installed as four individual cables for up to approximately 200 m between the point where the Marine Cables exit from the Landfall Horizontal Directional Drilling ('HDD') ducts on the seabed and the location where the trenching starts for the Marine Cables. Each HVDC Circuit will be capable of facilitating the transfer of up to 1000 MW, resulting in a total net power transfer capacity of up to 2000 MW, net of losses.

Cable System

3.5.3.2. The Marine Cables will use two Twin Symmetrical Monopole HVDC links each known as a HVDC Circuit. This enables the independent operation of each 1000 MW HVDC Circuit and therefore redundancy during operation.

Cable Design

3.5.3.3. It is anticipated the HVDC Marine Cables will use copper conductors with Cross Linked Polyethylene (‘XLPE’) insulation. This type of cable has an XLPE insulation extruded over the conductor and is covered with a water tight lead alloy sheath to protect against water ingress. Over the lead is a polyethylene anti-corrosion layer, bedding layer, galvanised steel armour wires with a polypropylene string layer overall.

3.5.3.4. Each individual Marine Cable will have a diameter of approximately 140 mm and an approximate weight of 50 kg/m (in air) where a copper conductor is used. Plate 3.2 illustrates the cross section of a typical marine XLPE cable.

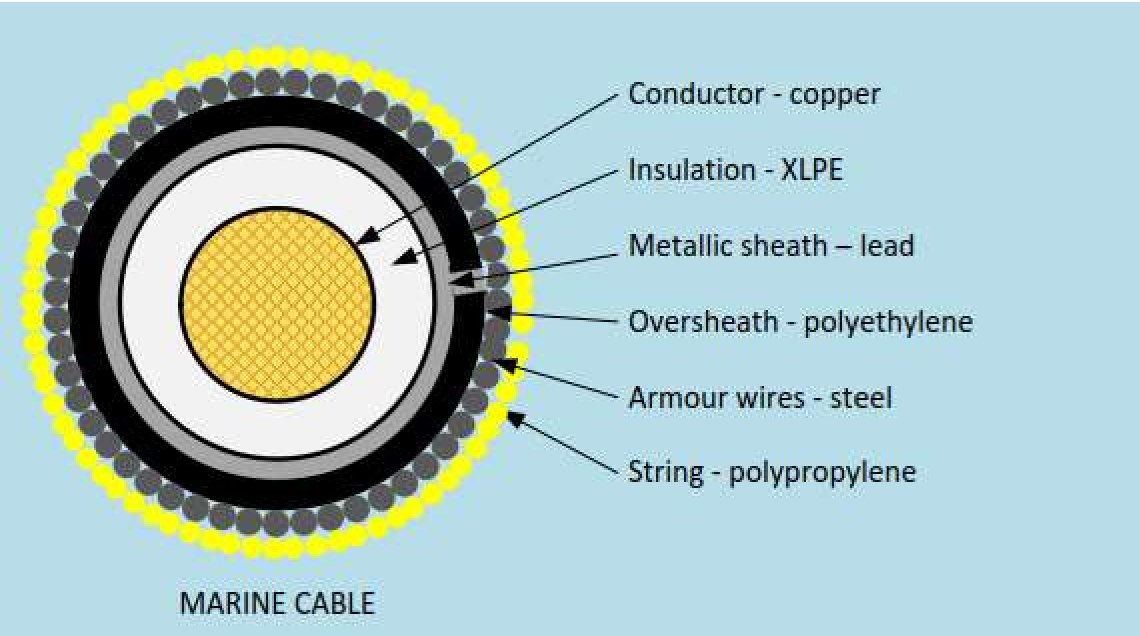

Plate 3.2 - Cross section of a typical Marine XLPE cable

3.5.3.5. Whilst some types of cable contain liquid oil for electrical insulation, XLPE cables contain no oil. The benefit of this is that if a cable is ruptured for some reason, no liquids or gases will be released into the environment.

3.5.3.6. The Marine Cables are designed, manufactured and installed for a minimum service life of 40 years.

Fibre Optic Cable (FOC)

3.5.3.7. In addition to the four Marine Cables, two FOCs, each 35-55 mm in diameter will be laid together with the Marine Cables within a shared trench (one FOC per HVDC Circuit). Each FOC will include fibres for a Distributed Temperature Sensing ('DTS') system as well as protection, control and communications.

3.5.3.8. Plate 3.3 illustrates the configuration of the Marine Cable showing one of the HVDC Circuits (comprising two Marine Cables) and an FOC. There will be two of these HVDC circuits installed.

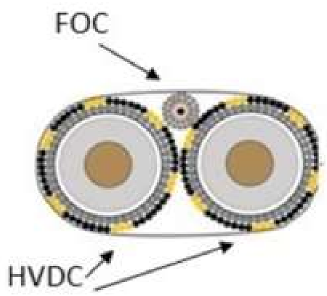

Plate 3.3 - Configuration of the HVDC Cables and FOC within the cable trench. Plate illustrates one HVDC Circuit (not to scale).

3.5.4. MARINE SURVEYS

3.5.4.1. Marine surveys have been undertaken in order to define the Marine Cable Corridor, target burial depths, cable installation techniques and the requirements for cable and scour protection. Marine surveys include benthic ecology, geophysical and geotechnical surveys.

3.5.4.2. The surveys listed above enable the identification of the following along the Marine Cable Corridor:

- Sediment types (surface and shallow geology);
- Marine benthic species and habitats;
- Sediment particle sizes and quality;
- Bathymetry and slopes;
- Seabed features (e.g. mobile sediments (sand waves and large ripples), boulders);

- Seabed debris (e.g. abandoned fishing gear);
- Marine heritage and archaeological features; and
- In-service and out of service ('OOS') cables and pipelines.

3.5.4.3. Figure 3.4 illustrates the surface and shallow geology along the Marine Cable Corridor obtained through analysis of the geophysical and geotechnical survey data. Further qualitative description of the characteristics and potential constraints of the Marine Cable Corridor identified by the geophysical survey can be found in Appendix 3.3, Table 1. Chapter 8 of the ES and Appendix 8.1 describe the results of the benthic ecology surveys.

3.5.4.4. Prior to the installation of the Marine Cables, further ground condition surveys will likely be required to be undertaken by the appointed contractors as part of a suite of pre-installation survey work. These surveys would identify whether there have been any physical changes to the seabed, refine the interpretation in any areas of data gap or uncertainty, identify any Unexploded Ordnance ('UXO'), capture the pre-construction condition at the proposed cable crossing, provide more detail for the landfall HDD alignments, and allow the Marine Cable Route to be finalised within the Marine Cable Corridor.

3.5.5. ROUTE PREPARATION FOR MARINE CABLE

3.5.5.1. Two types of preparation will be required prior to the installation of the Marine Cable:

- Clearance of obstacles and/or seabed features:
  - Seabed debris (OOS cables, wires, abandoned fishing gear);
  - Boulders;
  - Sandwaves and large ripples; and
  - Uneven seabed (gulleys, slopes, pits and free spans).
- Construction of crossing structures over in-service cables that are crossed by the Marine Cables.

3.5.5.2. A detailed UXO survey for the construction corridor will be undertaken as part of the pre-installation surveys. Where potential UXO are identified, the Marine Cable Route will be refined, where possible, to avoid the potential UXO exclusion zones. If UXO cannot be avoided, they may require removal/detonation. Removal or detonation of UXO will be undertaken by a registered Explosives and Ordnance Survey Disposal specialist contractor and will be subject to a separate marine licence. Permission for undertaking these activities will be sought through a separate marine licence(s) with the Marine Management Organisation ('MMO') outside the DCO process.

3.5.5.3. Analysis of data received to date has identified indicative areas along the Marine Cable Corridor where seabed preparation is required (Figure 3.5 and Appendix 3.3 Table 2).

3.5.6. MARINE CABLE INSTALLATION

3.5.6.1. Options for the installation of the Marine Cables are dependent upon the characteristics of the seabed and the presence of seabed features.

3.5.6.2. As illustrated in Figure 3.4, seabed sediments throughout the Marine Cable Corridor are highly variable; gravel, sand, silt and clay have been recorded.

3.5.6.3. The Marine Cables will be carried on a Cable Lay Vessel ('CLV') either on carousels or in cable tanks. The cables will be pulled via tensioners, overboard the vessel and on to the seabed. Depending on the burial technique adopted, trenching/burial can be simultaneous to cable lay, before cable lay (pre-lay or pre-cut trenching) or after cable lay (free-lay or post-lay burial):

- Simultaneous Cable Lay and Burial - buries the cable at the same time as it is laid on the seabed. This is typical of a ploughed system, where the cable feeds through the plough to its burial point. This can apply to ploughs, trenchers (wheel or chain), and jetting (including vertical injectors).
- Pre-lay (or pre-cut) Trenching - a trench is created into which the cable is subsequently laid. This can be undertaken by V-shaped (displacement) ploughs and dredging techniques. Time between cable lay and backfill should be minimised and is anticipated not to exceed 1-2 months.
- Free-Lay (or post-lay) Burial - burial that occurs after the cable has been laid on the seabed. This can apply to ploughs, trenchers and jet tools (most commonly the latter). Time between cable lay and burial should be minimised and is anticipated not to exceed 1-2 months.

Deep Water Cable Installation

3.5.6.4. Deep water installation refers to the installation of the Marine Cables in water depths of 10 – 15 m or greater. Approximately 88 – 100 km of the Marine Cable Corridor is within deep water.

3.5.6.5. Two types of CLV can be used for cable installation in deeper waters; dynamically positioned ('DP') vessels and cable lay barges ('CLB')

3.5.6.6. The primary difference between the two types of CLV is that DP vessels maintain their position using thrusters, whereas a CLB relies on an anchored mooring arrangement which is maintained using anchor handling vessels.

3.5.6.7. Based on the above, it is likely that both types of CLV will be required for cable installation in deeper water.

Shallow Water Installation

3.5.6.8. Shallow water installation refers to the installation of the Marine Cables in water depths less than 10 – 15 m. Approximately 9 – 21 km of the Marine Cable Corridor is in shallow water.

3.5.6.9. Specialised CLV, typically CLBs which have a shallower draft, are used for cable installation in shallow waters. Any ploughing and trenching equipment can be deployed from the barge to bury the Marine Cables.

3.5.6.10. There are several CLVs and CLBs with flat bottomed hulls that are designed to maximise the benefits of both barges and DP vessels. Under the right conditions, these vessels can ground on the seabed at low tide. However, the seabed at the approach to the Landfall contains rocks and boulders, therefore this approach is unlikely. Further seabed surveys will confirm whether this is the case or not.

Cable Burial

3.5.6.11. Cable burial can be achieved using ploughs, jet trenchers or mechanical trenchers. It is likely that a combination will be used for the Marine Cables, to take into account different water depths and seabed conditions. Further detail on the machinery used to facilitate cable burial is set out in Appendix 3.4.

3.5.6.12. The techniques presented in Appendix 3.4 cover those methods that would conventionally be used for construction of the Proposed Development. Trials of equipment, to demonstrate suitability, may be undertaken within the Marine Cable Corridor during the seabed preparation phase, or at the start of the construction stage.

Cable Burial Depth and Trench Widths

3.5.6.13. The depth to which the Marine Cables will be buried is dependent on local seabed characteristics, hydromorphological conditions and the risk and probability of likely hazards (i.e. snagging by fishing gear/anchors).

3.5.6.14. Burial depth has been informed by the results of the marine survey, with further information presented in Appendix 3.4.

3.5.6.15. The preliminary target depth of lowering ('TDL') to achieve burial protection against external hazards in UK waters generally varies from 1.0 m to 3.0 m. These target depths are from a stable seabed level, i.e. after clearance of significant sandwaves and large ripples.

3.5.6.16. If the TDL is not achieved, the actual depth of lowering will be reviewed and a decision taken as to whether additional remedial work (further attempts at burial or the use of non-burial protection such as placed rock or concrete mattresses) is required, or whether the achieved burial depth can be accepted based on a review of the applicable risk.

3.5.6.17. Typically, up to approximately 10% of a route requires remedial non-burial protection, although this is dependent upon ground conditions encountered, burial tools used, burial methodology, weather and other factors.

3.5.6.18. Table 3.2 below presents the anticipated TDL along the Marine Cable Corridor. The table also reflects the current anticipated proportion of each TDL length where non-burial protection may be required if TDL is not achieved. Note that non-burial protection for the HDD exit pit and cable crossing are not included in this table as these constitute planned protection. KP 0-1 is not included as this section is anticipated to be HDD.

Table 3.2- Anticipated TDL after bedform clearance (KP 1.0 -109.11)

TDL (m)	Length of Marine Cable Route	Proportion of Marine Cable Route	Anticipated length of Marine Cable Route at TDL where remedial non-burial protection may be required	Anticipated proportion of Marine Cable Route at TDL where remedial non-burial protection may be required
1.0	57.3 km	53%	1,200 m	2%
1.4	3.5 km	3%	100 m	2%
1.7	28.8 km	27%	2,900 m	10%
1.9	0.3 km	0.3%	100 m	10%
2.0	6.0 km	6%	600 m	10%
2.5	10.2 km	9%	4,100 m	40%
3.0	1.5 km	1%	1,500 m	100%

3.5.6.19. Trench widths would likely range from 0.35 – 3 m, depending on the type of burial equipment and whether the trench was made pre- or post- cable lay on the seabed. Trenches will be backfilled, either naturally or through backfill techniques using side cast or deposited dredge material or will be protected with alternative protection.

Cable Spacing

3.5.6.20. Whilst the proposed spacing is generally not to exceed 50 m between bundled cable circuits, there is the potential, particularly between approximately KP 42 – 50, that separation may be increased to minimise impacts within a section of particularly uneven bathymetry. The cable circuits will also be closer together at the transition between the HDD entry / exit pit where they exit as 4 separate cables, before they are combined into two bundled circuits. The final cable spacing requirements will be confirmed in the final design of the Marine Cables pursuant to conditions imposed on the Deemed Marine Licence which forms part of the Order (Document Reference 3.1).

Non-burial Protection Measures

3.5.6.21. Where it is not possible to bury the cable under the seabed to the target depth, non-burial protection will be required to protect the cables from anthropogenic (i.e. fishing and vessel anchoring) and natural hazards (i.e. currents and mobile sediments). Areas where the Marine Cables cannot be buried and where protection will be required include:

- In-service cable crossings (planned non-burial);
- Across boulder or gravel fields where seabed clearance has not been possible (unplanned non-burial);
- Areas of mobile sediment which are underlain by material in which minimum depth of lowering could not be achieved (unplanned non-burial);
- Where burial installation activities have been unsuccessful (i.e. cable was surface laid or minimum depth of lowering could not be achieved, or where the trenching system has had to be recovered, either to change technique, for repairs or due to poor weather) (remedial non- burial);
- At a cable joint / repair location (planned / unplanned non- burial); and
- At the transition between the Landfall HDD exit and the buried cable (planned non- burial).

3.5.6.22. Table 3.3 summarises the non-burial protection methods that are being considered for the Proposed Development.

3.5.6.23. Table 3.3 presents information that suggests that approximately 10.5 km of the Marine Cable Route will require remedial non-burial protection. A potential need for a further 500m of rock placement for preparation of uneven ground, which would also include 500m of non-burial protection above the cable, is described in Appendix 3.4. Therefore, a total of 11 km of non-burial protection is assumed.

3.5.6.24. Figure 3.5 identifies where planned non-burial protection methods are anticipated to be required and Appendix 3.2 provides the worst-case parameters for all non-burial protection requirements.

3.5.6.25. In order to prevent an incremental increase in non-burial protection during operation of the Proposed Development (i.e. for maintenance and repair) and to ensure that an allowance for the placement of non-burial protection for the operational phase of the project is assessed, an indicative contingency (10% of the cable route length) for the amount of protection required has been proposed for the first 15 years of operation. This contingency accounts for locations where cables become exposed (and cannot be adequately reburied), and where cable repairs are undertaken and following the repairs cannot be reburied.

Table 3.3 - Non-burial cable protection methods

Non-burial Protection	Description
Tubular Protection	Protective sleeves made of polyurethane or ductile iron within which the Marine Cable is placed. Commonly used in combination with mattresses or rock placement.
Mattresses (Frond and Concrete)	Pre-fabricated, flexible concrete coverings connected by polypropylene ropes which are laid on top of the cable to stabilise and protect it. The placement of mattresses is slow and as such is only used for short sections of cable. Typical dimensions are 6 m x 3 m and either 150 mm or 300 mm thick. There are variations dependent upon manufacturer. In areas of potential scour, frond mattresses could be used. Frond mattresses are designed to mimic natural seaweed to stimulate settlement of sediment over the cable. The mattresses comprise continuous lines of overlapping buoyant polypropylene fronds that, when activated, create a viscous drag barrier that significantly reduces current velocity. The frond lines are secured to a polyester webbing mesh base which is secured to the seabed, or connected to concrete mattresses.

Non-burial Protection	Description
Rock Placement	Placement of rocks of varying size to form a protective barrier over the Marine Cable. This method is typically used for scour protection, crossing of seabed infrastructure or where burial depth has not been reached. Typical dimensions are trapezoid, occasionally triangular, cross sections with heights of 0.5 – 1.5 m, top width of 1 – 3 m and side slopes of 1:3 to 1:4. They may comprise a filter layer and an armour layer, with grading defined accordingly.
Grout/Rock Bags	Bags filled with grout, sand or rock and placed over the Marine Cable. Generally applied to smaller areas or used for temporary works that have to be recovered.

Cable Crossings

3.5.6.26. The Marine Cable Corridor crosses one in-service cable; the Atlantic Crossing 1 at KP 72.5 (Figures 3.7 and 3.8) a subsea telecommunications cable which links the USA with three European countries. A cable crossing agreement will be put in place with the cable owners, in line with the relevant guidance. This agreement will detail the design and methodology for the cable crossing. It is anticipated that non-burial protection methods will be employed at the cable crossing.

Cable Sections and Joints

3.5.6.27. It will be necessary to install the Marine Cables in sections which are electrically connected via Cable Joints. These are either in-line (where one end is connected to the other and they can be installed in a straight line) or in certain circumstances during installation, and for any post-installation repairs, it may be necessary to use an omega joint (where the jointed section is laid on the seabed perpendicular to the cable alignment). It is not possible at this time to predict where omega joints will be required.

3.5.6.28. There are likely to be between 8 – 12 individual in-line joints per HVDC Circuit (16 – 24 joints in total at 4 – 6 locations). This does not include the joints that will be required between the Onshore and Marine Cable at the Transition Joint Bays ('TJB') at Landfall, which will be located above the MHWS mark.

3.5.6.29. Once installed on the seabed, the joints will be placed into a pre-dredged trench and/or placement of rock protection/mattress will be required.

3.5.6.30. Additional detail on cable sections and joints, including non-burial protection is included in Appendix 3.4.

3.5.7. MARINE CABLE INSTALLATION VESSELS

3.5.7.1. The number and specification of vessels required during installation activities will be determined by the appointed contractor. It is anticipated that several types of vessels will be required during installation of the Marine Cables. Table 3.4 summarises the likely type and number of vessels that will be utilised during the installation activities.

3.5.7.2. The location of the port facilities required to support installation activities has not yet been determined, local options include Southampton and Portsmouth. Smaller ports may be utilised for crew changes. Cable load out may happen at the manufacturer's facility which will be confirmed once the contracts are awarded or at local ports where cables will be shipped to by a manufacturer.

3.5.7.3. It is anticipated that installation vessels will have a rolling 500 m recommended safe passing distance for navigational safety purposes. Where barges are used for cable installation the recommended safe passing distance may increase to 700 m to accommodate the anchor spread. These works will be detailed through a Notice to Mariners ('NtM') prior to the commencement of works.

3.5.7.4. Where cable is laid but temporarily unprotected, (this may be as freelay cable, as pre-cut installation before backfilling, where Target Depth of Lowering has not been achieved, or where crossings are being constructed), guard vessels will be used to monitor the cable to prevent accidental damage from fishing or shipping where sufficient navigational risk exist. These are typically trawlers, spaced at 6 - 12 nmi intervals where the cable is at risk.

3.5.7.5. The information provided in Table 3.4 presents the worst-case with both HVDC Circuits being laid in parallel campaigns. Should parallel campaigns not be undertaken and the HVDC Circuits are laid separately, it is anticipated that this will require a lesser number of vessels but a similar number of movements, but does not account for weather down time. If a simultaneous lay and burial technique is used instead of pre-cut or free-lay, there will be a reduction in vessel numbers, due to a single vessel laying and trenching the cable, and reduced numbers of guard vessels will be required.

Table 3.4 - Indicative number of vessels and trips required for seabed preparation, cable installation and HDD works

Activity	Indicative no. of vessels	Indicative no. of return trips
Seabed Preparation		
PLGR, boulder removal, uneven seabed and cable crossings	10	54
Dredging / MFE/Disposal	1	9
Cable Burial Method (Pre-cut or Free-Lay)		
Main cable lay vessels, trench support vessels	8	20
Support vessels (e.g. anchor handler, remedial rock placement vessels, survey, guard vessels)	24	106
HDD Installation		
Jack up vessel / barge	1	1
Support vessels (e.g. safety vessel, anchor handler, crew transfers, tug)	7	635

3.5.8. LANDFALL INSTALLATION (MARINE)

3.5.8.1. The Landfall HDD operations will drill surface to surface boreholes under the Intertidal Area. The HDD method limits disturbance to the environment when compared with open trenching techniques. The holes will be lined with ducts through which the Marine Cables will be pulled into the TJBs at a later date as part of the cable installation activity. It is not determined yet whether the HDD direction will be onshore to marine, marine to onshore, or drilling from both ends.

3.5.8.2. The HDD is anticipated to comprise four bores, each approximately 1,400 to 2,000 m in length. The minimum and maximum depths will typically be up to 20 m, depending upon the length of the bore and the local ground conditions, with bores separated up to 20 m apart.

3.5.8.3. Whilst the drilling can take place from either the onshore or marine end, the lining duct will be pulled in from marine to onshore.

3.5.8.4. When drilling from the marine end, localised excavation/dredging of a pit/trench at the marine entry/exit location may be required for installation of the temporary casing required for drilling, and also to ensure that navigable depth is not reduced by more than 5%. These may be in the form of four individual pits (one for each duct) or a single trench for all four ducts.

3.5.8.5. The HDD plant will be set up on the jack up vessel which will then locate to the offshore entry point with a multicat and safety vessel. An excavator on the jack up vessel (or one of the other vessels) will be equipped with a vibro-hammer to install three to four temporary support lattices to support each of the 36” steel casings during drilling operations for each duct. The casings will need to be driven into the seabed until the end is at approximately 5 m depth to ensure that there is a good seal to avoid drilling fluid breakout. Each casing will take 2 x 12 hours shifts to install. To install both the trestle supports and the steel casings into the seabed, and relocate to the next duct location would take approximately 43 x 12 hour shifts for all four ducts. The overall HDD works (set up, driving casing, drilling and reaming bores, and installing ducts) is anticipated to take approximately 307 shifts (44 weeks).

3.5.8.6. A Cefas approved drilling fluid (bentonite based) would be employed to lubricate the drilling process and cool the drill head. Fluid pressures would be monitored throughout activities to reduce the risk for breakout of the drilling fluid.

3.5.8.7. Additional information on the Landfall installation (marine) is included in Appendices 3.2 and 3.4.

3.5.9. MARINE CABLE OPERATION AND MAINTENANCE

Maintenance Surveys

3.5.9.1. The Marine Cable Route and burial depths and/or non-burial protection will be designed to minimise the requirement for regular inspection surveys. However, further surveys may be required throughout the operational lifetime of the Proposed Development.

3.5.9.2. It is anticipated that inspection surveys would be undertaken every 6 – 12 months for the first 2 – 5 years, then reducing in frequency to once every 1 – 5 years for the operational lifetime of the Project, with further details on survey requirements within Appendix 3.4. There may be other survey requirements relating to cable crossing agreements and any requirements of relevant Port Authorities.

Maintenance, Repair and Operation

3.5.9.3. The Marine Cables have been designed so that routine maintenance to the Marine Cables is not required during their operational lifetime. However, there may be the requirement to undertake unplanned repair works, due to the following events:

- Mechanical/electrical failure of components within the cables;
- Exposure of, or damage to, the cables as a result of fishing activities and/or vessel anchoring; and
- Exposure of cables due to changes in seabed morphology (e.g. areas of free spanning) or changes in hydrodynamics (e.g. increase in bed erosion due to dredging works in the vicinity of the Marine Cables).

3.5.9.4. Based on industry studies on failure rates in subsea cables, applied to the Proposed Development's circuit length and design life, it is assumed that an indicative worst-case failure rate of the buried or otherwise protected Marine Cables (including internal and external failures) would lead to a repair every 10 – 12 years.

3.5.9.5. If repair works are required, it is likely that the repairs would be undertaken by a single vessel, likely to be an anchored barge in shallow water (<10 – 15 m) or a DP vessel in deeper water (>10 – 15 m). Typically, repair works would require exposure of the cable at the point where the fault is identified, cutting the cable where damaged, recovery to the surface, repair and re-deployment and re-burial to the seabed as an omega joint using methods similar to those employed during installation. This is likely to include a requirement for rock placement. Further information on repair is included in Appendix 3.4.

3.5.9.6. In addition, the FOC will monitor the operational performance of the Marine Cables. Temperature and vibration monitoring will be undertaken to monitor the performance of the cable, particularly in areas known to be at risk from interference i.e. areas of known mobile sediment, shipping grounds, anchoring ground and commercial fishing areas. In the event that anomalies are recorded, further investigation and, if necessary, corrective action will be undertaken.

Electric and Magnetic Fields (EMF)

3.5.9.7. Within each of the two HVDC Circuits, one cable will have positive polarity and one negative. The magnetic field produced by each cable within the bundle would be equal and opposite, producing a very low resultant magnetic field i.e. far below the limit stated by the International Commission on Non-Ionising Radiation ('ICNIRP') guidelines for DC magnetic fields which is 40,000 μT ("micro Tesla"), which would be applicable onshore. Furthermore, the Marine Cables will be buried throughout approximately 90% of the Marine Cable Corridor which will further reduce the magnetic field on the surface of the seabed as illustrated in Table 3.5, with further details included in Appendix 3.4.

Table 3.5 - Estimated magnetic field emissions at various cable depths

Distance from Cable (m)	Magnetic Field from Marine Cables (μT)
0.5	165
0.6	116
1	42
2	11
3	5
4	3
5	2
6	1

Heat

3.5.9.8. Heat is lost during the transmission of electricity as a result of the resistance of the conductor material within the Marine Cable. A study undertaken to inform the Nemo Link Interconnector project calculated that localised temperature increases in the seabed above the cables would be 1.2°C at 30 cm depth and 0.7°C at 10 cm depth (Nemo Link, 2013).

3.5.9.9. Emissions of heat to the surrounding marine environment are anticipated to be minimal as the cable will be buried for much of the Marine Cable Corridor up to depths of between 1 - 3.0 m. In addition, the natural movement of tides and currents will dissipate any heat that reaches the surface of the seabed.

3.5.10. DECOMMISSIONING OF MARINE CABLES

3.5.10.1. The Marine Cables will be designed, manufactured and installed for a minimum service life of 40 years.

3.5.10.2. Decommissioning activities would be determined by the relevant legislation and guidance available at the time of decommissioning in line with the options and principles included in Appendix 3.4. In addition, a decommissioning plan will be developed and agreed with The Crown Estate.

3.6. PROPOSED DEVELOPMENT - ONSHORE

The description of the onshore elements of the Proposed Development is structured as follows:

- National Grid Connection Works;
- Converter Station Area;
- Onshore Cable Corridor;
- Landfall;
- Operation and Maintenance; and
- Decommissioning.

3.6.1.1. The Project connects to the UK and French electrical transmission networks. This section of the Chapter describes the Onshore Components of the Proposed Development, starting at the National Grid Lovedean Substation and finishing at the MLWS in Eastney, where the Onshore Cable is jointed with the Marine Cable at the Landfall. Full detail of the Onshore parameters is included within Appendix 3.5.

3.6.2. NATIONAL GRID CONNECTION WORKS

3.6.2.1. To facilitate the connection to the National Grid Lovedean Substation, it will be necessary to provide additional electrical infrastructure. The electrical connection equipment at Lovedean Substation is expected to be a combination of Air Insulated Switchgear ('AIS') and Gas Insulated Switchgear ('GIS').

3.6.2.2. It will be necessary to connect two HVAC Cable circuits (each comprising three cables). One connection point is proposed to be located on the western side of the Lovedean substation and the other on the eastern side of the substation for each HVDC Circuit, as shown in Plate 3.5.

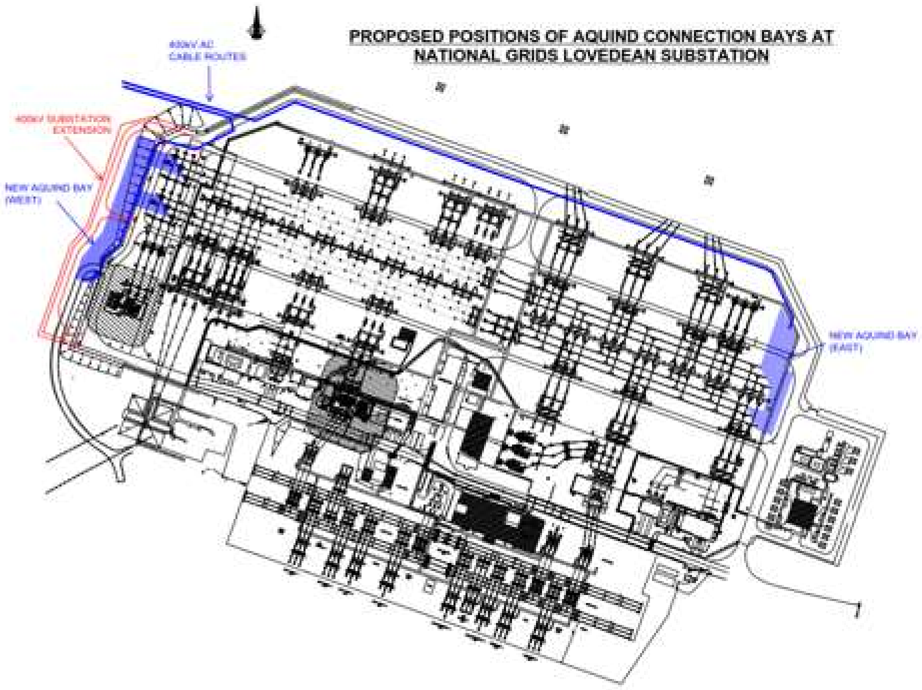

Plate 3.4 - Proposed Eastern and Western connection bays at Lovedean Substation.

3.6.2.3. Each bay would require a Portable Relay Room ('PRR'), to accommodate associated protection and control cubicles and batteries. The PRR manage the data signal from the equipment and sends it on to the control centres for the Converter Station and Lovedean Substation. Further detail of the National Grid connection works is included in Appendix 3.5, section 1.1.2.

HVAC Cable

3.6.2.4. The HVAC Cable Corridor through which the HVAC Cables will be installed is proposed within the area of land between Lovedean Substation and the proposed Converter Station and located within the area identified for Works No. 1 shown on the Works Plans (Document Reference 2.4).

3.6.2.5. The HVAC Cables, providing the link between the Converter Station and National Electricity Transmission System via Lovedean Substation, will be located within the HVAC Cable Corridor and will be up to 1 km in length. The HVAC Cables are proposed to exit from the Converter Station on its eastern side.

3.6.2.6. There will be two 400 kV HVAC Circuits that will connect the proposed Converter Station to the Lovedean Substation. Each HVAC Circuit will sit in a single trench. It is anticipated that one circuit would enter Lovedean Substation on its north-western boundary to connect to the western bay and the second circuit would route along the northern side of Lovedean Substation, to connect to the second bay, which will be located on the eastern side of the substation.

3.6.2.7. Installed alongside the HVAC Cables may be an earth continuity conductor, which is an insulated metallic conductor to provide a path to earth for any fault currents.

3.6.2.8. There is also a requirement for an FOC to be installed alongside each HVAC Cable Circuit for control and protection and cable monitoring purposes. An indicative cross-section is shown in Plate 3.6.

3.6.2.9. Electric fields from the HVAC Cables will be contained by the cable's protective metal sheath. Further information on EMF from other Onshore Components is available in Appendix 3.7.

AQUIND

HVAC Cable Construction Principles

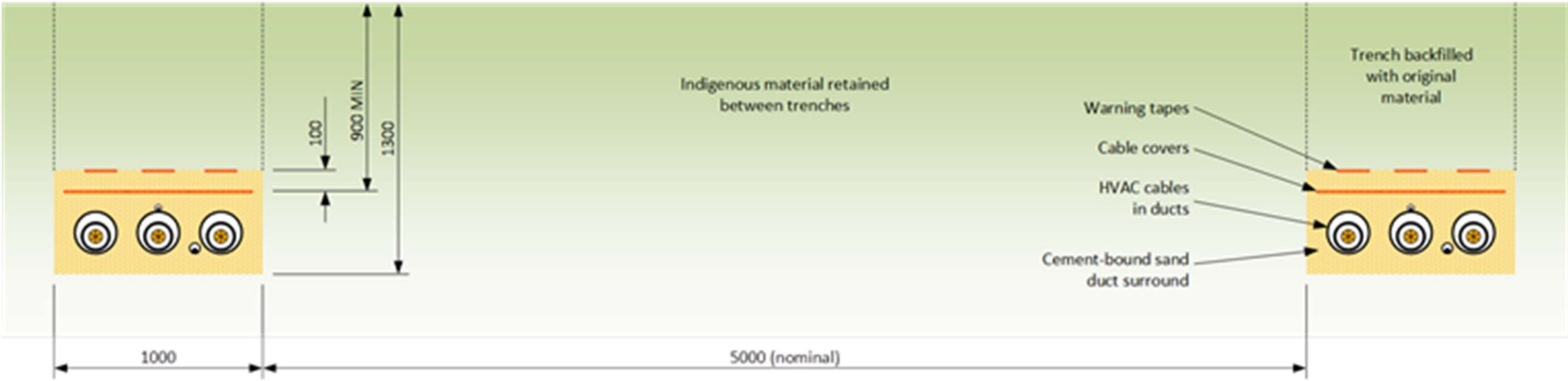

Plate 3.5 - Typical arrangement of HVAC cables and FOC in ground (all measurements in mm).

3.6.2.10. The burial depth across agricultural land and open countryside is typically 900 mm to the top of the protection covers. Where practicable, for cable rating integrity a minimum buffer of 2 m on either side of the cable trench to major tree roots will be employed (see Figure 3.11). A nominal separation distance of approximately 5 m between HVAC Circuits will ensure that the circuits are electrically and thermally independent of each other resulting in an overall working width of 23 m, which will vary depending on the local environment and selection of cable design.

3.6.2.11. It is anticipated that the HVAC Cables will utilise a ducted and troughed installation method, with ducts installed underground between the Converter Station and Lovedean Substation prior to the HVAC Cables being pulled through.

3.6.2.12. The design and configuration of the HVAC Cables will be subject to detailed design and may be impacted upon by elements such as soil conditions, length of the HVAC Cable Route, impact from the environment and existing infrastructure.

3.6.3. CONVERTER STATION AREA

3.6.3.1. As discussed in Section 3.2.1.2 a Converter Station is required to convert electricity from HVDC, used to transmit electricity between the UK and France, and HVAC, used to transmit electricity within the National Electricity Transmission System in both countries. Figure 3.10 shows the Converter Station Area and its components within the Order Limits. It is located within the area identified for Works No. 2 shown on the Works Plans (Document Reference 2.4).

3.6.3.2. The proposed Converter Station area footprint is 200 m x 200 m (4 ha), and will be located within a securely fenced compound. The finished ground floor slab level would be 300 mm above the Converter Station finished site level (i.e. top of gravel chipping) as recommended by the WSP Flood Risk Assessment Report, Appendix 20.1.

3.6.3.3. Plate 3.7 below, shows an indicative Converter Station layout illustrating the electrical equipment and structures required.

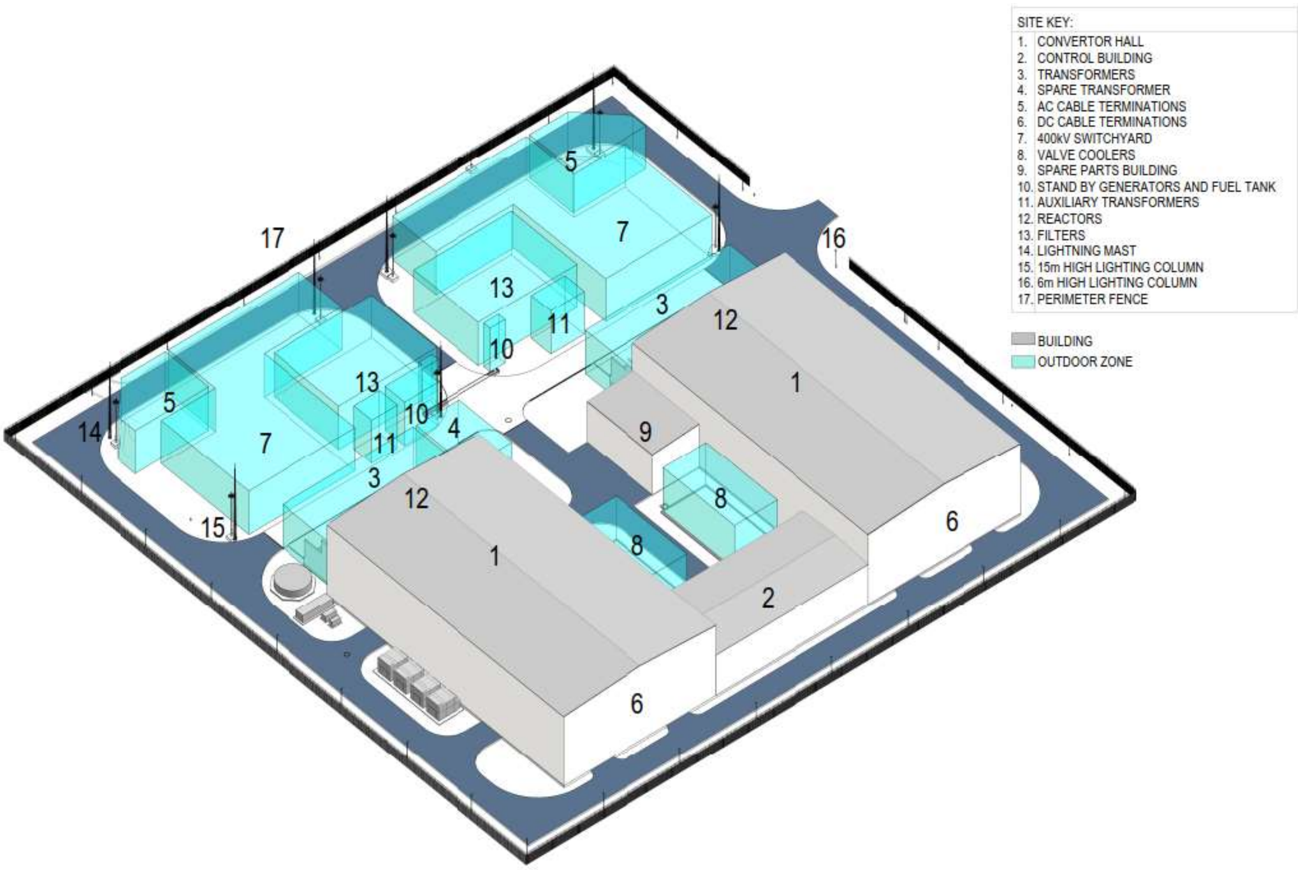

Plate 3.6 - Indicative Converter Station layout

3.6.3.4. The Converter Station consists of a number of interconnected components which need to be connected sequentially, with the built form for each dictated to a high degree by their function.

3.6.3.5. The components are arranged whilst considering the most efficient connection method between them and the minimum spacing of the equipment to ensure safe operation and maintenance.

3.6.3.6. The outdoor equipment which forms part of the proposed Converter Station will be similar to the equipment that is found within typical electrical substations, such as the adjacent Lovedean Substation. The 400 kV switchyard (item 7 in Plate 3.7), transformers (item 3 in Plate 3.7) and AC filters (item 13 in Plate 3.7) will be located outdoors.

3.6.3.7. This conversion equipment is housed indoors, within the two Converter Buildings (item 1 in Plate 3.7). Each Converter Building will comprise of a steel structural frame and will measure approximately 90 m in length, 50 m in width and up to a maximum of 26 m in height to be measured from finished ground floor slab level. Power Electronics are required to convert the power between AC and DC or vice versa.

3.6.3.8. A full height reinforced concrete wall (maximum 26 m) will be constructed to the transformer's elevation to provide 4hr fire protection. The remaining walls to the Converter Buildings will be designed to provide 1hr fire resistance. The building will be divided internally to provide an AC hall, Valve Hall and DC Hall. The building will also include the valve cooling system.

3.6.3.9. The Control Building (item 2 in Plate 3.7) would be located between the two Converter Buildings and will comprise a two-storey building with steel frame structure and suitable cladding to match the adjacent buildings with a maximum overall height of 15 m, to be measured from finished ground floor slab level.

3.6.3.10. Internally, the Control Building would be divided to provide control and protection plant rooms, Heating, Ventilation and Air Conditioning rooms ('HVA/C'), battery rooms, workshops, office, meeting room, mess room, shower room and WCs. Internal walls would comprise fairfaced (smooth) dense concrete blockwork to provide 1hr fire resistance between adjacent rooms.

3.6.3.11. The spare parts building (item 9 in Plate 3.7) will comprise a maximum 15 m high single storey steel frame structure with cladding to match the adjacent buildings. Internal construction would comprise a reinforced concrete floor slab suitable for supporting uniform imposed loads and a 2.4 m high internal perimeter for robustness. Appropriate road and access ramp/s would be provided to the building to facilitate plant access to the storage area through appropriately sized roller shutter doors.

3.6.3.12. The lightning masts can generally be up to 4 m taller than the tallest building, are tall, narrow structures, with catenary wiring strung between them to shield the outdoor equipment from direct lightning strikes. These are likely to be located around the HVAC yard (see item 14 in Plate 3.7).

3.6.3.13. The Converter Station will be lit, when necessary, using energy efficient luminaries mounted atop mid-hinged columns to provide ease of maintenance. Lighting columns, up to 15 m high (see items 15 and 16 in Plate 3.7) are proposed to illuminate the outdoor areas of the Converter Station during emergency situations, such as an intruder or unplanned maintenance work. The lights are not intended to be used during normal operation.

3.6.3.14. The Converter Station will require a distribution connection, i.e. a medium voltage AC supply from the Distributed Network Operator ('DNO'), Scottish and Southern Energy Networks ('SSEN'). A connection request will be submitted to SSEN, who will be responsible for designing and providing the connection point for this supply. This supply is a back-up for the Converter transformer tertiary supply fail. SSEN have identified three potential connection points to the existing 11 kV network, including connection points near Little Denmead Farm, Broadway Lane or Denmead Mill.

3.6.3.15. Back-up sources such as stand-by diesel generators will be only used if other sources of auxiliary supply are unavailable during the construction and operation phases.

3.6.3.16. Cooling systems will be required to remove heat generated within the Converter Building. Part of these systems, specifically the fans and pipework related to them, will be located outside the Converter Building. The rest of the cooling system such as pumps, control system and remaining pipework related to the system will be located within the building.

3.6.3.17. The Converter Station is designed for unmanned operation, but a small team of maintenance staff (typically 3 – 4) will be responsible for maintaining the plant and will be on 24/7 callout, if required.

3.6.3.18. The Converter Station will be designed, manufactured and installed for a minimum service life of 40 years. Due to the dynamic nature of power electronics, the control system may need to be replaced at 15-20 years. Some equipment may need to be refurbished/replaced one or more times during the service life of the Interconnector. Additional detail on the operation and maintenance of the Converter Station is included in Appendix 3.5, section 1.1.3.

3.6.3.19. It is proposed to provide two attenuation ponds at the Converter Station in relation to drainage requirements, as follows:

- South side of the proposed Converter Station to collect run-off from the Converter Station
- Northwest of the proposed Access Road to collect run-off from the main access road through drainage ditch alongside of the Access Road.

3.6.3.20. The attenuation ponds will be designed to cater for extreme rainfall events up to and including the 1 in 100 year return period rainfall event, which has an annual exceedance probability of 1% with an additional allowance of 40% for climate change. The attenuation ponds are discussed in more detail in the individual topic chapters, where relevant. Further details on surface water drainage and aquifer contamination within the Converter Station Area is included within Appendix 3.6.

Telecommunications Buildings

3.6.3.21. FOC Infrastructure will be used for communications between the French and UK Converter Stations in connection with the control and protection systems, and hence the FOC is required to be installed with both HVAC and HVDC Cables. Additionally, the FOC will continue to monitor the condition of both the Onshore and Marine Cables.

3.6.3.22. The FOC will have sufficient fibres to accommodate levels of redundancy for failures, and it is also the intention that fibres within the cable may be used for commercial telecommunications purposes. The industry standard for the amount of fibres within a single cable continues to increase as technology develops.

3.6.3.23. It is proposed that two Telecommunications Buildings (one for each HVDC Circuit) will be located in close proximity to the Converter Station to house required telecommunications equipment. The Telecommunications Buildings associated with the FOC are anticipated to be located outside the main Converter Station security fence. This is to enable the equipment to be more easily accessible for maintenance purposes and in connection with the proposed use of fibres for commercial telecommunications purposes.

3.6.3.24. Each Telecommunications Building will have a maximum footprint of 8 m long x 4 m wide x 3m high and will also have secure fencing, access and parking for up to two vehicles for maintenance purposes. It is currently anticipated that the compound for the Telecommunications Buildings would have a maximum size of 10 m x 30 m with an indicative layout illustrated in Plate 3.8.

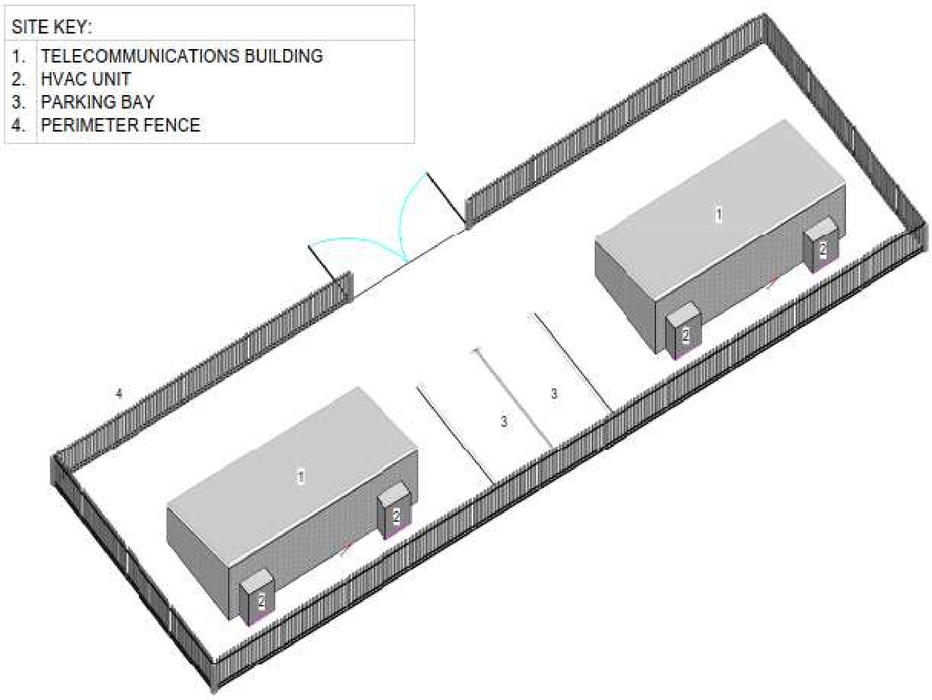

Plate 3.7 - Indicative Telecommunications Buildings Compound layout

3.6.3.25. It is anticipated that a Telecommunications Building would contain a shared internal space where equipment could be installed within separate sealed cubicles. It is also anticipated that the building will accommodate shared ancillary facilities including: an office; welfare facilities and storage areas.

Access Road

3.6.3.26. The proposed access to the Converter Station for construction and operation will be taken from Broadway Lane and Day Lane, with associated highway improvements in the vicinity of the junction of these two highways.

3.6.3.27. The Access Road to the Converter Station will be approximately 1.2 km in length, and is expected to be a standard width (no wider than 7.3 m) suitable for transportation of Heavy Goods Vehicles ('HGVs') and Abnormal Indivisible Loads ('AIL').

3.6.3.28. During general maintenance and operational outages, access by maintenance staff is typically light vehicles (e.g. cars, vans) and use of HGVs or AILs will only be required in the rare event of a major equipment failure. AIL vehicles would be required on the rare occasion that a transformer, or other similarly large plant, is required to be replaced at the Converter Station.

3.6.3.29. The Access Road is likely to cross up to four of the ten 132 kV oil filled cables associated with the SSEN substation adjacent to the Lovedean Substation. Crossing of SSEN circuits, if required, will be undertaken under a separate agreement with SSEN in the detailed design phase.

3.6.3.30. In addition, a 11 kV SSEN wood pole overhead line running parallel to Broadway Lane would be replaced with an underground cable to provide clear access for the Access Road to the Converter Station Area. This work is expected to be classed as non-contestable works and as such SSEN are expected to undertake the works and secure their wayleaves for the change of their network infrastructure.

Location Siting, Massing and Design Approach

3.6.3.31. The Converter Station Area comprises land to the north, west and south of the existing National Grid Lovedean Substation, within the area identified as Works No. 2 on the Works Plans (document reference 2.4)

3.6.3.32. The precise siting of the Converter Station Compound is yet to be confirmed, but will be located west of the existing Lovedean Substation with two options considered in the Order:

- Option B(i) - Blue
- Option B(ii) - Green

3.6.3.33. These options are identified on the Parameter Plans (Document References 2.6) and shown on Plate 3.9.

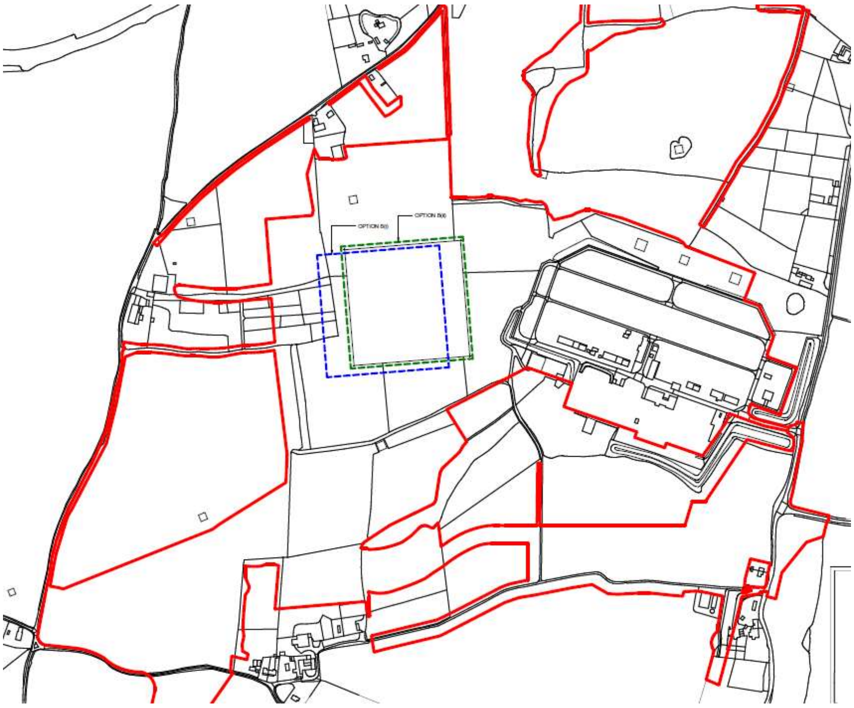

Plate 3.8 - Converter Station Parameter Plans (two options, Option B(i) Blue dash and Option B(ii) Green dash)

3.6.3.34. The Converter Station will be located in one of the two option areas, with the final siting to be confirmed following the Order being made. In addition, areas are identified for where the Access Road and the Telecommunications Buildings will be constructed.

3.6.3.35. Within each option, zones are identified where the buildings and electrical equipment may be located which are subject to maximum height restrictions. The buildings and electrical equipment that may be located in each of the identified zones are included within a requirement in the Order, with each type of building or equipment subject to maximum parameters regarding it's massing.

3.6.3.36. The identification of the zones in which the buildings and infrastructure may be located dictate to a degree the layout of the electrical equipment, which as identified previously is constrained by the need for the individual components to be connected sequentially, with the built form for each dictated to a high degree by their function.

3.6.3.37. In addition, the orientation of the zones within each option has given particular consideration to the need to screen surrounding receptors from likely significant effects as a consequence of the operation of the Converter Station, for example noise. These considerations, where relevant, are more fully described in the relevant topic chapters which form part of this ES.

3.6.3.38. The spatial extent of both options has been assessed for the purpose of the EIA to ensure a robust assessment of the likely significant effects.

3.6.3.39. Further, whilst the design of the buildings and electrical infrastructure are dictated to a high degree by their function, the Applicant has given consideration to the how those buildings may be designed so as to minimise the likely significant environmental effects associated with the visual appearance of the Converter Station. A set of design principles has been established, which will dictate the requirements for the final design of the Converter Station. The design principles, and more generally the approach to the design of the Converter Station and associated electrical and telecommunications equipment, is detailed in the Design and Access Statement (Document Reference 5.5).

Construction of Converter Station Area

3.6.3.40. The construction and commissioning works for the Converter Station are currently anticipated to be undertaken between 2021 – 2024.

3.6.3.41. A construction compound will be located within the Converter Station Area for the duration of the construction which shall have facilities for mess, welfare and approximately 150 car parking spaces (Works No.3 on the Works Plans (Document Reference 2.4).

3.6.3.42. Temporary fencing will be used to secure the areas under construction during the construction works.

3.6.3.43. The proposed Converter Station is located on a hillside sloping downwards from North to South. Given the topography of the Converter Station Area, bulk earthworks would be required to create a level platform to accommodate the Converter Station. To keep the excavation within structureless chalk strata to mitigate contamination of the aquifer, 84.80m AOD has been proposed as Converter Station general finished level. Following initial Flood Risk assessment, the Converter Building finished floor level has been proposed to be 85.10m AOD (300mm above finished site level). Therefore, for the basis of the EIA assessment, 85.10m AOD has been used.

3.6.3.44. Preliminary foundation assessment has concluded that the foundations are likely to be a combination of conventional ground bearing and piles dependent on the location, loading and acceptable settlement and differential settlement.

3.6.3.45. The construction of the platform for the main Converter Station site will be one of the initial activities undertaken. It is usual/standard practice for the site establishment, fencing/hoarding, bulk earthworks (and related drainage works) and site access road works to be undertaken as an initial enabling works preparation contract. This allows construction works to concentrate on the activities which construct the site working platform and access, the completion of which allows the rest of the main site works to commence.

3.6.3.46. The Converter Station construction works will comprise of: Converter Building, Control Building, Spare Parts Building, valve cooling plant, transformers, external electrical switchgears, site access roads and car parking areas suitable for the number of operational staff and visitors anticipated as being on the site at any one time. Concrete hardstanding/pavement areas will be provided in oil containment and heavy-duty pavement areas, including heavy reinforced concrete skidways for transformer installation.

3.6.3.47. Cable trench works will be required comprising: precast concrete trenches for Love Voltage ('LV'), multi-core and control cabling on the Convertor Station site.

3.6.3.48. Building service works comprising: below ground utilities, floodlighting, LV electrical/alarms/controls and HVAC Cable works, fire deluge systems, pipes, hydrants, tanks and pumps will be carried out following the main construction works.

3.6.3.49. Landscaping (including reprofiling if/where appropriate and associated planting) is proposed around the perimeter of the Converter Station compound and at other necessary/appropriate locations to mitigate against the landscape and visual amenity impacts and integrate the proposed Converter Station into its surroundings. The relevant environmental effects and the consequence of embedded mitigation from a landscape and visual amenity perspective are discussed in Chapter 15 of this ES, with relevant ecological considerations discussed at Chapter 16.

3.6.3.50. Temporary laydown areas in connection with the construction of the Converter Station are likely to have a total footprint of approximately 4 – 5 ha. Vegetation will be removed in specific areas and some earthworks may be required to create a level platform, which will be covered with up to 400 mm of crushed stone. This area will be in use for the duration of the construction and commissioning stages, and restored thereafter.

3.6.3.51. At the peak of construction, up to 86 HGV movements per day are envisaged, with up to 20 telescopic cranes and approximately 150 personnel on site. The impacts associated with construction traffic are discussed in more detail in Chapter 22, Traffic and Transport, to this ES.

3.6.4. ONSHORE CABLE CORRIDOR

Approach to the siting of the Onshore HVDC Cables

3.6.4.1. The Onshore Cable Corridor represents the maximum extent of the area within which the Onshore Cables may be located, otherwise described as the limits of deviation. It is necessary to ensure flexibility for the siting of the Onshore Cables within the limits of deviation so as to ensure statutory undertaker apparatus can be effectively navigated and the installation of the Onshore Cables can be optimised by the chosen contractor following the making of the Order (see Appendix 3.1 for further detail). The final siting will be required to be confirmed for each part of the Onshore Cables in accordance with requirements provided for in the Order.

3.6.4.2. Two HVDC Circuits are proposed to be installed in the Onshore Cable Corridor between the Converter Station and the Landfall, the length of these circuits will be approximately 20km.

3.6.4.3. Each circuit will contain two HVDC Cables and one FOC and will be installed independently from one another. Each circuit could be installed at different times by different contractors.

3.6.4.4. Joint Bays will need to be positioned at approximately 600 m to 2,000 m intervals along the route.

3.6.4.5. For the majority of the Onshore Cable Route the HVDC Cables will be installed in excavated trenches. Rather than being laid in the trench, a form of housing (known as cable ducts) will be installed in the trenches. At a later date after sections of ducts have been installed, lengths of cables will be pulled through the ducts.

3.6.4.6. Joint Bays will be required at points along the route, and these will be used for pulling the cable through the cable ducts before joining one section of cable to another. The number of joint bays along the length of the cable route is dictated by the length of cable that can fit on a cable drum (the drum-shape reel on which the cable is stored prior to installation) and limits to the pulling tension required to pull the cable through the ducts. Joint Bays are likely to be required every 600m to 2000m along the HVDC Circuits and will be positioned in highway verges, fields or car parks, where possible, to limit the need for road closures. The distance between Joint Bays will depend on the technique employed by the contractor and therefore flexibility as to the number and location of Joint Bays is sought in the Order.

3.6.4.7. Link Boxes are typically located alongside a Joint Bay and are accessed via a man-hole cover, installed at the same level of the surrounding ground. The dimensions of a Link Box are approximately 0.8 m x 0.8 m x 0.6 m. Link Pillars are frequently used on arable land (instead of Link Boxes) and they are normally located adjacent to hedgerows. They are accessed via doors at the front of the Link Pillar and the dimensions are approximately 1.0 m x 1.0 m x 0.6 m. The Link Boxes (or Pillars) are connected to the metal casing of the joint via underground bonding leads.

3.6.4.8. Cable systems are reliable and do not tend to require intrusive maintenance. At the Link Box/Link Pillar locations, electrical connections between the HVDC Cables can be removed, enabling tests to establish the integrity of the cable oversheaths during commissioning, regular maintenance, and in the event of suspected damage. Cable tests would be carried out approximately every two years or before re-energisation of the interconnector after an outage period.

3.6.4.9. Details on the onshore electric and magnetic fields is included in Appendix 3.7, confirming compliance with public exposure guidelines.

Description of the Location and Land Use Characteristics of each section

3.6.4.10. To aid design development and environmental assessment the Onshore Cable Corridor has been divided into ten sections, as set out below. The description of the Onshore Cable Corridor sections assumes Trenching as the method of installation unless otherwise stated.

3.6.4.11. There are expected to be six locations along the Onshore Cable Corridor where the ducts will be installed by HDD or Trenchless methods. Locations and anticipated construction durations are provided in Table 3.6.

Onshore Cable Corridor Section 1 – Lovedean (Converter Station Area)

Summary of Section 1

3.6.4.12. Within Section 1 is an area in which the Onshore Cable will be located as it approaches the proposed Converter Station. Apart from the existing Lovedean Substation, pylons and overhead transmission lines, the area is predominantly rural, comprising agricultural land and woodland as well as a number of residential properties around the peripheries of the Order Limits. The section is located within Winchester City Council and East Hampshire District Council.

Route Description

3.6.4.13. The Onshore Cable Corridor will run further south from the Converter Station Area through the agricultural fields before running south-west to the unnamed road between Old Mill Lane and Broadway Lane which it will cross.

Onshore Cable Corridor Section 2 – Anmore

Summary of Section 2

3.6.4.14. Section 2 encompasses the area between the unnamed road between Old Mill Lane and Broadway Lane to the north and Anmore Road to the south and is a predominantly rural area comprising agricultural land. The section is located wholly within Winchester City Council.

Route Description

3.6.4.15. The Onshore Cable Corridor runs south from the unnamed road between Old Mill Lane and Broadway Lane through agricultural land towards the properties located north of Anmore Road. There is flexibility to run the HVDC Cables south to Anmore Road through land belonging to Hillcrest Children’s Services and/or land to the east or west of Hillcrest Children’s Services. The Onshore Cable Corridor then crosses Anmore Road to the eastern extent of Kings Pond Site of Importance for Nature Conservation (‘SINC’) and continues south into Section 3.

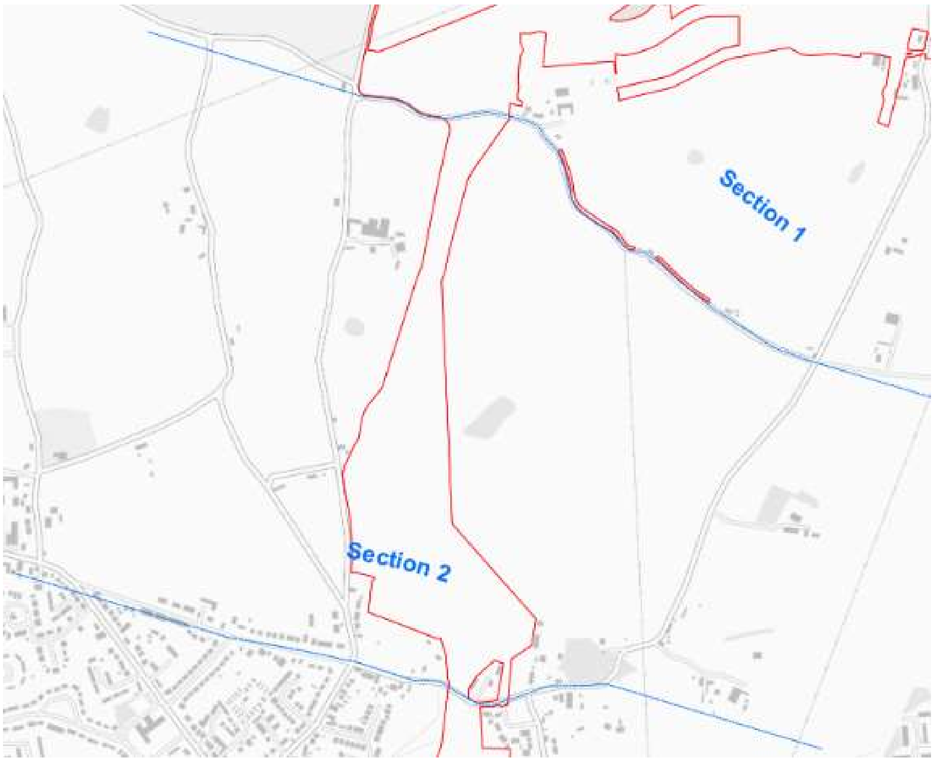

Plate 3.9 - Order Limit of Section 2

Onshore Cable Corridor Section 3 – Denmead/Kings Pond Meadow

Summary of Section 3

3.6.4.16. Section 3 encompasses the area between Anmore Road and the junction of Hambledon Road and Soake Road. It is a predominantly rural area comprising agricultural land located to the east of the settlement of Denmead and west of the settlement of Waterlooville with a number of dispersed agricultural and residential properties. The area forms part of the Denmead Gap (a planning policy designation to prevent the coalescence of Denmead and Waterlooville). The area immediately south of Anmore Road comprises Kings Pond Meadow SINC with agricultural land known as Denmead Meadows located further south. The B2150 Hambledon Road runs in a south-easterly direction through the southern part of this section. This section is located wholly within Winchester City Council.

Route Description

3.6.4.17. The Onshore Cable Corridor runs south from Anmore Road through the Kings Pond Meadow SINC and also comprises the field located east of the SINC which will accommodate the northern compound of HDD 5. The Onshore Cable Route would then be installed by HDD to the southern compound. Flexibility has been retained as to where the southern compound could be located. It could be located north of Hambledon Road where the Onshore Cable Route would join the B2150 Hambledon Road and run south-easterly towards Waterlooville. If the southern compound is located south of Hambledon Road the Onshore Cable Route will run in a south-easterly direction either within Hambledon Road or the northern extent of the fields south of Hambledon Road before re-joining Hambledon Road and continuing towards Waterlooville.

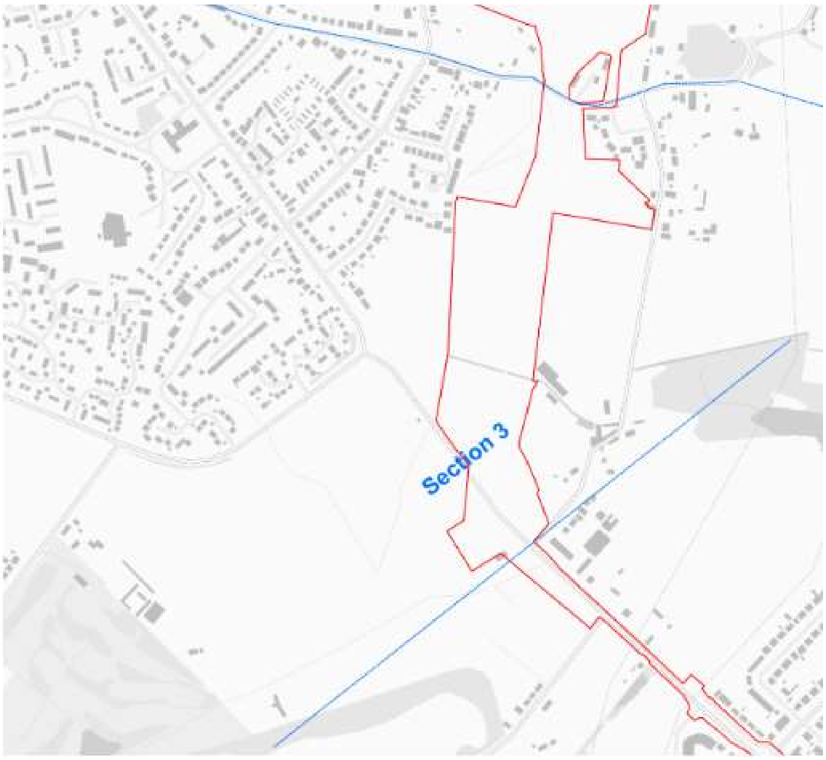

Plate 3.10 - Order limit of Section 3

Onshore Cable Corridor Section 4 – Hambledon Road to Farlington Avenue

Summary of Section 4

3.6.4.18. Section 4 is a predominantly urban area encompassing the B2150 Hambledon Road and A3 London Road running southwards between the West of Waterlooville Major Development Area and land predominantly owned by the Southwick Estate (to the West) and Waterlooville, Purbrook and Widley (to the East). At the southern end, the section includes the junction of the A3 London Road and the B2177 Portsdown Hill Road as well as land between this junction and the northern part of Farlington Avenue, including the Portsdown Hill Road Car Park which also incorporates the northern area of the Meadow West of Farlington Avenue SINC. The section spans Winchester City, Havant Borough and Portsmouth City Councils.

Route Description

3.6.4.19. The Onshore Cable Corridor runs predominantly within the Highway Boundary, along the B2150 Hambledon Road. It continues south along the A3 London Road from Maurepas Way roundabout through Waterlooville, Purbrook and Widley and under the B2177 Portsdown Hill Road bridge before turning east up the slip road to Portsdown Hill Road. The Onshore Cable Route will run along Portsdown Hill Road or will run through the car park immediately south of Portsdown Hill Road before continuing south-east down Farlington Avenue.

3.6.4.20. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Portsdown Hill open space and car park details of the anticipated location and duration of impact is detailed in Table 3 of Appendix 3.5.

Plate 3.11 - Order limit of Section 4 – (1 of 4)

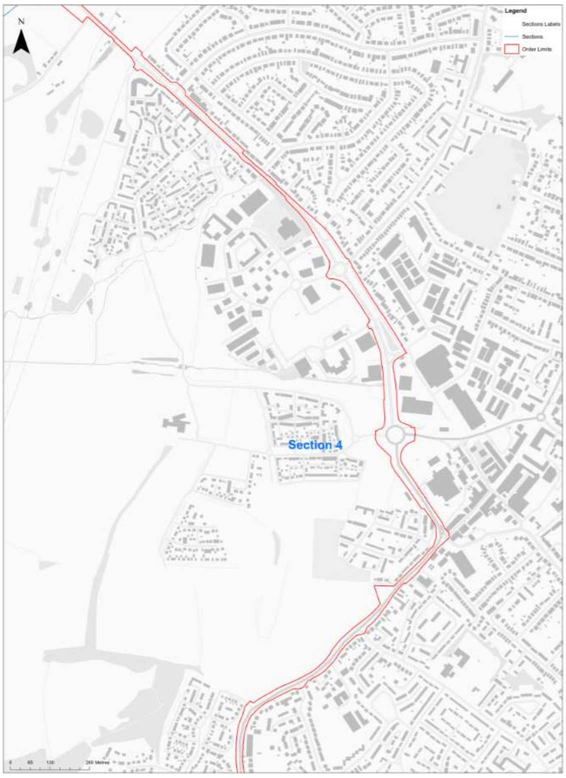

Plate 3.12 - Order limit of Section 4 - (2 of 4)

Plate 3.13 - Order limit of Section 4 - (3 of 4)

Plate 3.14 - Order limit of Section 4 – (4 of 4)

Onshore Cable Corridor Section 5 – Farlington

Summary of Section 5

3.6.4.21. Section 5 is located within the urban areas of Drayton and Farlington, suburbs of Portsmouth, and encompasses the highway of Farlington Avenue, Evelegh Road (south of Solent Infant School), Havant Road, the area of open land between Evelegh Road and Havant Road, and the northern part of Eastern Road. The section is located wholly within Portsmouth City Council.

Route Description

3.6.4.22. The Onshore Cable Corridor continues in a southerly direction along Farlington Avenue to Havant Road, turning east along Havant Road before continuing south via Eastern Road into Section 6.

3.6.4.23. Flexibility is provided in this section with a potential to run the Onshore Cable Route east along Evelegh Road before turning south via the area of open land between Evelegh Road and Havant Road before turning west to the junction of Eastern Road (A2030) and continuing south via Eastern Road into Section 6.

Plate 3.15 - Order limit of Section 5

Onshore Cable Corridor Section 6 – Zetland Field and Sainsbury's Car Park

Summary of Section 6

3.6.4.24. Section 6 is located within Farlington, an urban area of Portsmouth, and includes the A2030 Eastern Road, the western part of Zetland Field and western side of the Sainsbury's car park north of the Network Rail railway line. The section is located wholly within Portsmouth City Council.

Route Description

3.6.4.25. The Onshore Cable Corridor runs in a southerly direction along the A2030 Eastern Road to the northern extent of Zetland Field where the Cable Route will either continue within the carriageway of Eastern Road or will run through Zetland Field to Fitzherbert Road before continuing south via the western side of Sainsbury's car park. At the southern end of the car park the Onshore Cable Route will pass under the railway line, using a Trenchless technique (HDD 4) from a compound within Sainsbury's car park to a compound within Section 7.

3.6.4.26. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Zetland Field details of the anticipated location and duration of impact is detailed in Table 3 of Appendix 3.5.

Plate 3.16 - Order limit of Section 6

Onshore Cable Corridor Section 7 – Farlington Junction to Airport Service Road

Summary of Section 7

3.6.4.27. Section 7 is located within Farlington and Baffins, both of which are urban areas of Portsmouth, and includes a large area of Farlington Playing Fields and Langstone Harbour (a SSSI, SPA, SAC and Ramsar site). It also includes land at Kendall's Wharf (a wharf used for processing and distributing marine dredged aggregates) and the amenity land south of Kendall's Wharf which includes two football pitches, one of which is used by Baffins Milton Rovers FC, a cricket pitch and areas used for storing equipment used by Tudor Sailing Club and the Andrew Simpson Watersports Centre. The section is located wholly within Portsmouth City Council.

Route Description

3.6.4.28. The Onshore Cable Corridor passes from a compound at the southern end of Section 6 under the railway line using Trenchless techniques to a compound located at the northern end of in Farlington Playing Fields. The Onshore Cable Corridor continues to the south-eastern extent of Farlington Playing Fields to the area where the northern compound for HDD 3 will be located. The Onshore Cable Corridor will then progress via HDD under the A27, Langstone Harbour and the north-western corner of Kendall's Wharf to the southern compound which will be located in the yard located south-west of Kendall's Wharf.

3.6.4.29. Access and egress to Farlington Playing Fields will be via the existing access road to the playing fields, accessed from Eastern Road. Flexibility has been retained to use the existing car park north of the Holiday Inn Express to support the construction works within Section 7.

3.6.4.30. From the HDD 3 southern compound, the Onshore Cable Corridor continues south, along the west side of the pitch used by the Baffins Milton Rovers FC, the cricket pitch and the southern football pitch across the car park and into Eastern Road.

3.6.4.31. Flexibility is maintained for the Onshore Cable Route to run east of the pitch used by the Baffins Milton Rovers FC through a yard used by Tudor Sailing Club and the Andrew Simpson Watersports Centre before running in a south westerly direction across the southern part of the cricket pitch and the west side of the southern football pitch across the car park and onto Eastern Road.

3.6.4.32. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Farlington Playing Fields, Kendalls Wharf and Baffins Milton Rovers Football Club and playing fields details of the anticipated location and duration of impact is detailed in Appendix 25.5 (Illustrative Phasing of Works at Example Public Open Spaces) of the ES Volume 3 (document reference 6.3.25.5).

Plate 3.17 - Order limit of Section 7 – (1 of 2)

Plate 3.18 - Order limit of Section 7 – (2 of 2)

Onshore Cable Corridor Section 8 – Eastern Road (adjacent to Great Salterns Golf Course) to Moorings Way

Summary of Section 8

3.6.4.33. Section 8 is within the urban area of Portsmouth and comprises the A2030 Eastern Road and the verges to its eastern side. Great Salterns Golf Course is located to the west and Langstone Harbour is located further east. Milton Common, large parts of which were formerly used as a landfill, is located at the southern end of Section 8 and is also a designated SINC. This section is located wholly within Portsmouth City Council.

Route Description

3.6.4.34. The Onshore Cable Route will run south within the carriageway of Eastern Road between Airport Surface Road and Burrfields Road (opposite Great Salterns Harvester). South of this point it will run in the highway and/or the verge of the highway of Eastern Road to the northern end of Milton Common.

3.6.4.35. It is anticipated that the Onshore Cable Route would progress through the corridor adjacent to path which runs from north to south through the Common, parts of which form the coastal flood defences. At the northern part of the coastal defences a short HDD (HDD 6) will be required below the bund of the coastal defences. The Onshore Cable Route would then continue south adjacent to the path to the south-east corner of Milton Common.

3.6.4.36. Whilst it is considered that there is a potentially viable route through Milton Common, given the nature of the ground conditions associated with its former landfill use, flexibility is maintained should further ground investigations find the conditions unsuitable for the development with two alternative routes also included within this Section for the Onshore Cable Corridor.

3.6.4.37. The two alternative routes continue along Eastern Road and will either run along Eastern Road or the western edge of Milton Common to Moorings Way or continue further south along Eastern Road to the junction with Eastern Avenue, where it would continue south-east along Eastern Avenue to Moorings Way.

3.6.4.38. These two alternative routes would then continue along the southern edge of Milton Common or within Moorings Way to the south-east corner of Milton Common adjacent to Moorings Way before continuing south to Section 9. If one of these two alternative routes was used, the verge and cycle path east of Eastern Road would be used where possible.

3.6.4.39. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Milton Common, details of the anticipated location and duration of impact is detailed in Table 3 of Appendix 3.5.

3.6.4.40.

Plate 3.19 - Order limit of Section 8 – (1 of 2)

Plate 3.20 - Order limit of Section 8 – (2 of 2)

Onshore Cable Corridor Section 9 – Moorings Way to Bransbury Road

Summary of Section 9

3.6.4.41. Section 9 encompasses the area between the southern end of Milton Common and Bransbury Road at the south east corner of Bransbury Park. This area contains the University of Portsmouth Langstone Campus, the Thatched House (public house), Milton Locks Nature Reserve and SINC, the Eastney and Milton Allotments, the grassed area north-east of Kingsley Road and Bransbury Park. The section is located wholly within Portsmouth City Council.

Route Description

3.6.4.42. Flexibility has been retained in the northern part of this section where the Onshore Cable Corridor contains both Furze Lane which is adopted highway and land to the east side of the University of Portsmouth Langstone Campus.

3.6.4.43. The Onshore Cable Route may continue south down Furze Lane and east along Locksway Road into the car park west of the Thatched House.

3.6.4.44. Alternatively, the Onshore Cable Route could progress south through the playing fields at the east side of the University of Portsmouth Langstone Campus before continuing west along Longshore Way to the car park west of the Thatched House.

3.6.4.45. A HDD compound will be located in the car park west of the Thatched House from which HDD 2 will be undertaken and will run under Eastney and Milton Allotments to a compound located to the north-east side of Kingsley Road. An area has been identified in the car park to the east of the Thatched House for temporary use to accommodate the HDD installation works.

3.6.4.46. Whilst the HDD will take place under the Eastney and Milton Allotments, access will be required over the paths within the Allotments during installation works for monitoring purposes.

3.6.4.47. From the grassed area north-east of Kingsley Road, the Onshore Cable Route continues towards Bransbury Park. Flexibility has been retained to run the Onshore Cable Route through Yeo Court to Bransbury Park and/or along Kingsley Road to the junction with Ironbridge Lane before turning south through the pedestrian access to Bransbury Park.

3.6.4.48. The Onshore Cable Corridor continues south through Bransbury Park to the west of the skate park before running east of the pavilion to Bransbury Road.

3.6.4.49. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Kingsley Road Open Space and Bransbury Park details of the anticipated location and duration of impact is detailed in Table 3 of Appendix 3.5.

Plate 3.21 - Order limit of Section 9

Onshore Cable Corridor Section 10 – Eastney (Landfall)

Summary of Section 10

3.6.4.50. Section 10 runs from Bransbury Road at the south east corner of Bransbury Park to the Landfall. The area is urban in nature. The Landfall is located in the car park south of Fort Cumberland Road, adjacent to the Land West of Fort Cumberland SINC. Fort Cumberland SINC and Scheduled Ancient Monument are located further east. The area also incorporates a section of Eastney Beach, a designated SINC. The section is located wholly within Portsmouth City Council.

Route Description

3.6.4.51. The Onshore Cable Corridor runs east via Bransbury Road, Henderson Road and Fort Cumberland Road within the highway to reach the car park south of Fort Cumberland Road.

3.6.4.52. The car park will be the location of the temporary northern compound of the HDD from TJB to Marine Cable Corridor (HDD 1) which will run in a south-south-easterly direction under Southsea Holiday Home, Lodge & Leisure Park and Eastney Beach to a point off-shore.

3.6.4.53. The TJB, where the Marine Cables and Onshore Cables (and FOC) will also be jointed together, will be located in this car park.

3.6.4.54. The two Optical Regeneration Stations required in connection with the FOC will be located at the northern end of the car park (section 3.6.5) as illustrated in the Indicative Optical Regeneration Station(s) Parameter Plan (document reference 2.11)

3.6.4.55. The exit point of the HDD is expected to be approximately 1,400 to 2,000 m in length from the TJB in the Marine Cable Corridor. As discussed in Section 3.3.81, it is not determined yet whether the HDD direction will be onshore to marine, marine to onshore, or drilling from both ends.

3.6.4.56. Where the Onshore Cable Route impacts on publicly accessible open space, in this Section Fort Cumberland Road car park details of the anticipated location and duration of impact is detailed in Table 3 of Appendix 3.5.

Plate 3.22 - Order limit of Section 10

Onshore Cable Construction Principles

3.6.4.57. A typical cross-section of the cable trench arrangement within the highway is shown in Plate 3.24, showing each HVDC Circuit in its own trench. The FOC is installed alongside each HVDC Circuit. Each circuit may be installed by separate contractors, at different times. The cross-section below is based on a standard cable installation design. An indicative cross-section of the construction corridor in which the Onshore HVDC Cables and FOC are installed in non-highway corridors is shown in Plate 3.25.

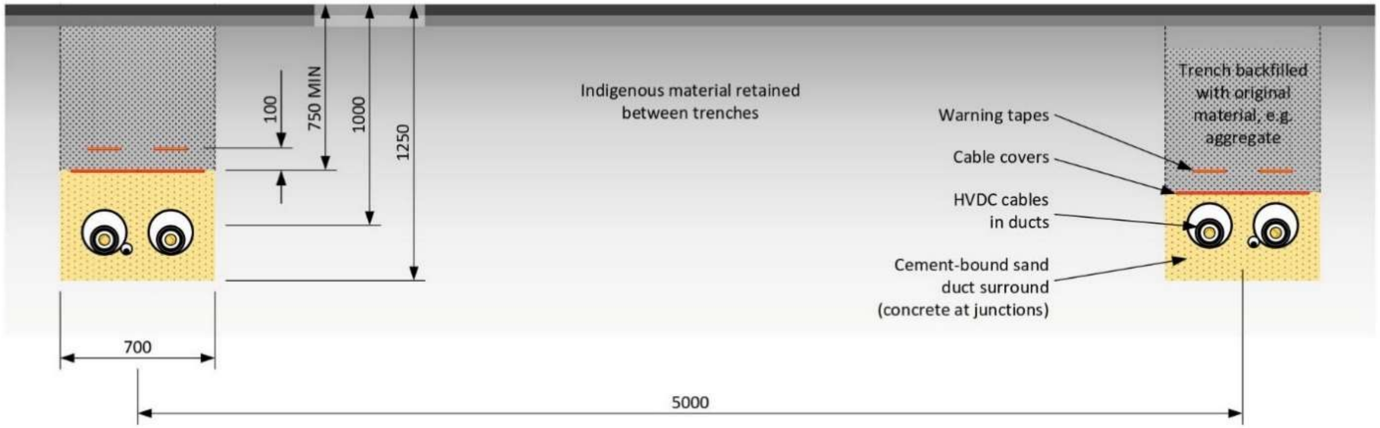

Plate 3.23 - Typical arrangement of HVDC and FOC cables in roads, verges and footpaths (all measurements in mm)

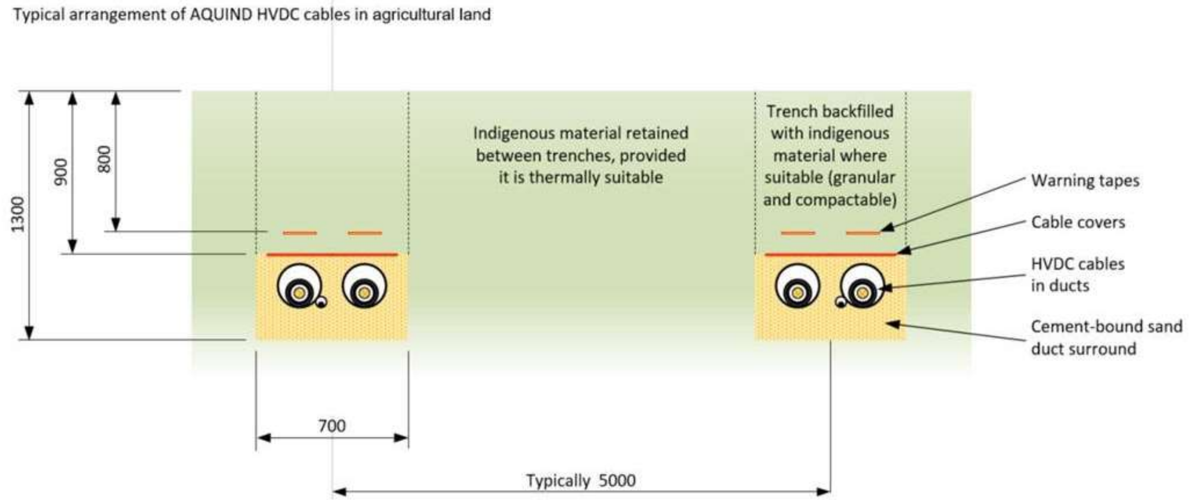

Plate 3.24 - Typical arrangement of HVDC and FOC cables in non-highway land (all measurements in mm)

3.6.4.58. Where necessary, a spacing of approximately 5 m is maintained between the trenches, to ensure the thermal independence of each circuit. Each excavated trench would be approximately 0.7 m in width, but could increase to 1 m in order to facilitate the cables being installed deeper, when navigating existing utility services.

3.6.4.59. To minimise disruption, cable ducts will be used for trenching. There will be three ducts per trench to accommodate the two cables comprised in a HVDC Circuit and one FOC. This allows short sections to be worked on at any one time and each length of cable subsequently pulled through at a later date, rather than needing to fully excavate each 600 m - 2,000 m length.

3.6.4.60. Following the laying of the ducts, the trench will be backfilled with a material with suitable thermal resistivity, such as cement bound sand (material will vary subject to the spacing of the trenches). The trench will also include a protection slab above the ducts and buried warning tape. The surface of the land in which the HVDC Cables are laid will then be reinstated.

3.6.4.61. The installation of ducts minimises the duration of trenching operations, and allows highways to be reinstated more quickly. The cables are subsequently pulled through the ducts in sections.

3.6.4.62. However, there may be occurrences where the cables will have to be laid/pulled in open trenches to be able to more precisely navigate around existing utility services or obstacles. Where it is necessary to increase installation depth to clear existing services it may be necessary to increase the distance between ducts to avoid de-rating the circuits (i.e. when the cables operate at the maximum temperature and do not achieve the maximum required current carrying capacity).

3.6.4.63. Due to the significant number of existing utility services within the Onshore Cable Corridor, it is expected that the installation rate for cable ducts for one circuit will be approximately 18 m – 30 m per day and typically in 100 m sections, within urban areas and approximately 50 m per day in open countryside. These typical installation rates are per gang per shift and are dependent upon the level of obstacles and utility services encountered within the road or constraints that need to be observed to minimise the impacts during construction.

3.6.4.64. Temporary laydown compounds may be required for cable drum and accessory deliveries and temporary storage of cable laying plant. The site offices for the cable route installation will be sited within the construction compound for the Converter Station, discussed at paragraph 3.6.3.40 above.

3.6.4.65. Where the Onshore Cable Route is in or immediately adjacent to roads, the installation will require traffic management measures. To minimise disruption, a single lane closure would be used, where practicable, rather than a full road closure. The construction impacts in relation to traffic and transport and strategies to be deployed to minimise those impacts are discussed in Chapter 22, Traffic and Transport, to this ES.

3.6.4.66. Jointing of the cables will require the area of each joint bay to be fenced. Typically, in addition to the excavated Joint Bay (one per circuit), there would be:

- One container for storage and a workshop;
- Welfare facilities;
- Generator, quiet where appropriate, and fuel;
- Temporary shelter installed over the joint bay, to provide a suitable environment for assembling the joints;
- Space at one or both ends of the joint bay for cable installation; and
- Space for parking operatives' vehicles.

3.6.4.67. The jointing operation is performed in joint bays which are located underground in line, or off to one side of the Onshore Cable Route. Images of typical joint bays are included in Plate 3.27. Each excavation will be approximately 15 m x 3 m, with additional space required at ground level for construction, cable installation, jointing and reinstatement, including a 20 m x 6 m 'compound' during jointing (for approximately one week). The excavation would typically be up to 1.7 m deep in roads, footpaths and verges and 1.85 m deep in fields. The completed underground JB will be approximately 6 m by 3 m and be 1.85 m in depth.


Plate 3.25 - Typical joint bays (image courtesy of Prysmian)

3.6.4.68. Cable winches will pull the cable through the duct system. The area around the winch will be fenced off and designated as a construction zone.

3.6.4.69. Typically, it would take approximately 20 working days to complete one joint bay location. This timescale includes the excavation, set-up, cable pulling, jointing, bonding connections, testing and reinstatement (i.e. site cleared and reinstated to its original state).

3.6.4.70. Once completed, backfilled and reinstated, the joint bays, like the rest of the HVDC Cables, will not be visible. The only evidence of the presence of the HVDC Cables will be Link Boxes or Link Pillars at certain points along the route.

Horizontal Directional Drill Installation

3.6.4.71. As explained above at paragraph 3.6.4.12, in certain areas the Onshore Cables will be installed in ducts using HDD or other Trenchless installation methods.

3.6.4.72. The timescale in the table below includes the mobilisation, the HDD works, de-mobilisation and reinstatement (i.e. site cleared and reinstated to its original state) and is based on a single operation.

Table 3.6 - HDD/Trenchless Durations and Locations

Trenchless Crossing Area	Duration for single operation	Compound locations
Landfall (HDD) **HDD-1**	44 weeks*	Fort Cumberland Road car park and UK Marine Area
Eastney and Milton Allotments (HDD) **HDD-2**	12 weeks	Thatched House Public House car park and open land north of Kingsley Road
Langstone Harbour (HDD) **HDD-3**	31 weeks	Kendall's Wharf and Farlington Playing Fields
Farlington Railway Crossing (Trenchless) **HDD-4**	26 weeks	Farlington Playing Fields and southern extent of Sainsbury's car park
Kings Pond (HDD) **HDD-5**	13 weeks	Kings Pond Field and field north of Anmore Road
Milton Common (HDD) **HDD-6**	2 weeks	East and West of northern flood defence bund at Milton Common

*(60 weeks including TJB works)

3.6.4.73. A Micro-Tunnelling technique is common for crossing of Network Rail assets in comparison with other Trenchless techniques such as HDD, and for this reason, micro-tunnelling is anticipated to be the method used to cross the railway north of Farlington Playing Fields. This alternative method of trenchless installation enables cables to be installed within ducts or pipes under a feature with minimal impact on that feature.

3.6.4.74. It is anticipated that HDD will be used in the other five areas to allow cables to cross under certain constraints along the route, namely waterways and environmentally sensitive areas (see Figure 3.13).

3.6.4.75. The HDD operation drill bores through the ground into which the cable ducts are pulled, through which the HVDC Cables will be pulled at a later date. The maximum depth will typically be between 5 m and 20 m, depending upon the length of the crossing and the local ground conditions.

3.6.4.76. The maximum depth for the micro-tunnelling will typically be 5 m, with the final depth depending upon the local ground conditions.

3.6.4.77. The HDD operations require a suitable space for the temporary construction area, which can typically be up to approximately 50 m x 50 m depending on the length and size of the HDD works. The HDD operations require a working area to locate the drilling rig, water bowser/pump, generator, layout of ducts/pipes and other construction equipment.

3.6.4.78. The HDD bores that are required for each of the four HVDC Cables would have to be suitably spaced to achieve the required cable rating. Typically, this spacing is approximately 5 m between adjacent ducts at the entrance and exit of the HDD and may increase to approximately 15 m depending on burial depth. The maximum width of cable reserve (area required for installing the four individual HVDC Cables with suitable spacing between taking in to account the maximum burial depth) has therefore been assumed to be approximately 60 m.

3.6.5. LANDFALL

3.6.5.1. The Landfall, located at Fort Cumberland car park south of Fort Cumberland Road in Eastney, was chosen following a detailed site selection process, described in Chapter 2 Consideration of Alternatives.

3.6.5.2. The Landfall forms the transitional area between the Onshore Cables and Marine Cables. The Marine Cables will be pulled ashore and jointed to the Onshore Cables at the TJBs.

3.6.5.3. HDD has been identified as the most suitable cable installation method at the Landfall, as opposed to open trenching methods. The use of HDD ducts avoids trenching through the beach and ensures that the cables are well protected in the shallow water immediately offshore. Cables installed by trenching could be vulnerable to damage, without the provision of additional protection.

3.6.5.4. The landward ends of the ducts will be approximately 200 m inland of, and at a higher elevation than, the MHWS mark. Section 3.5.8.1 provides further information on the HDD methodology specific to the shore landing.

3.6.5.5. To amplify the signal of the FOC across the full distance of the Cable between the French and UK converter stations, up to two Optical Regeneration Station(s) ('ORS') (one for each circuit) are to be located within Fort Cumberland car park at Eastney

3.6.5.6. Each ORS will have dimensions of up to 10 m long x 4 m wide x 4 m high, which would house signal amplification and control equipment associated with the FOC, required to ensure the signal strength is adequate between the UK and French Converter Stations. For safety purposes is necessary for them to be located 10 m apart.

3.6.5.7. The ORS would be located within a securely fenced compound, which would also contain auxiliary power generation equipment and a fuel tank (required for back-up power in the event of disruption in the local mains power supply). Refer to Plate 3.28 for indicative layout.

3.6.5.8. It is currently anticipated that the compound for an ORS would have a maximum size of 18 m x 35 m. Within the compound, it is anticipated that there will be parking for up to two vehicles to facilitate maintenance of the ORS infrastructure.

3.6.5.9. The proposed foundations are likely to have a depth of approximately 1.0 m for foundation construction (including 0.6 m thick concrete slab built on 0.4 m of consolidated hardcore layer.

3.6.5.10. The final external design of the ORS will be subject to approval in accordance with the requirement in the Order. Design principles to be adhered to when seeking the approval of the final design are provided for in the Design and Access Statement (Document Reference 5.5). In addition, principles for landscaping to facilitate the screening of the ORS is included in the Landscape and Biodiversity Strategy (Document Reference 6.10).

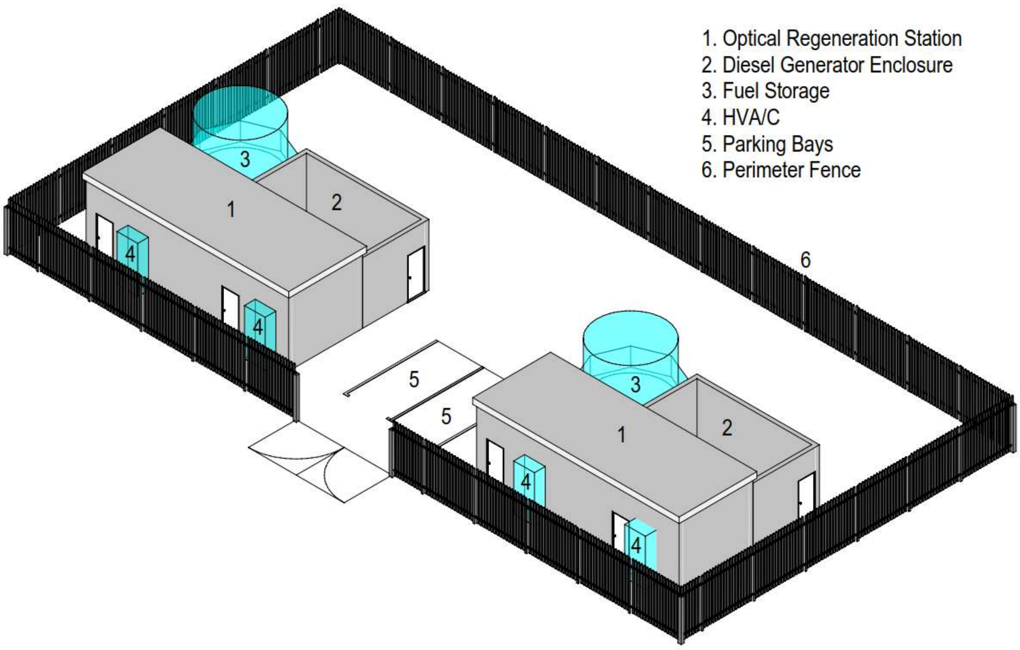

Plate 3.26 - Indicative Optical Regeneration Station Compound Layout

Principles of Installation and Construction Works

3.6.5.11. There will be two TJBs, one per HVDC Circuit. Each TJB will require an excavation of approximately 15 m x 5 m, to a depth of up to 1.75 m. Once the joint is complete, these excavations are backfilled and the land reinstated.

3.6.5.12. During the construction works, an area of approximately 15 m x 5 m adjacent to the TJBs is required for the jointing workshop, storage, parking, generator, welfare and security.

3.6.5.13. The Cables will be pulled into the TJB, ready for jointing. During the cable pulling operation, an area of approximately 15 m x 12 m at either end of the TJBs are required for the cable drum and stand, plus space for delivery and offloading of cable drums (at one end) and the winch and anchor (at the other end).

3.6.5.14. The TJB installation works will take approximately 16 weeks (total for both circuits).

3.6.5.15. The ORS compound construction is expected to take 12 weeks.

DECOMMISSIONING

3.6.5.16. The Applicant is seeking consent for installation of the Proposed Development for an indefinite period. The Converter Station will be designed, manufactured and installed for a minimum service life of 40 years. Major items of equipment (e.g. transformers, circuit breakers, reactors) are designed to meet the lifetime of the Proposed Development and should remain operational for their design life subject to regular maintenance, inspection and availability of spare parts. If the Proposed Development and associated equipment is deemed to have reached the end of its design life, then the equipment may be decommissioned in an appropriate manner, and all materials reused and recycled where possible.

3.6.5.17. It is anticipated that the HVDC Cable's operational lifetime will exceed that of the Converter Station equipment, however at the end of the HVDC Cable's asset life, the options for decommissioning will be evaluated. The preferred option with the least environmental impact is to leave the cable in-situ within the buried ducts.

3.6.5.18. Further information on the decommissioning and the potential impacts associated with it is provided in the topic chapters to this ES.

3.7. CONSTRUCTION ENVIRONMENT MANAGEMENT PLAN AND PROGRAMME ASSUMPTIONS

3.7.1.1. A Construction Environment Management Plan ('CEMP') will be produced in accordance with the Marine and Onshore Outline CEMP's for each of the relevant parts of the Proposed Development. Each CEMP would explain how the activities of contractors and sub-contractors would be required to comply with its requirements, including where necessary the production of subsidiary plans in relation to specific construction matters. The Outline CEMP's are contained in Document Reference 6.5 (Marine) and 6.9 (Onshore).

3.7.1.2. In addition, work to install the Onshore Cables in the highway will be required to comply with the Framework Traffic Management Strategy (Document Reference 6.3.22.2), with individual Traffic Management Strategies to be produced for all locations where the Onshore Cable is buried in, or impacts on, the uninterrupted use of the highway by vehicular traffic.

3.7.1.3. The description of the assumed programme for the construction of the Proposed Development is based on the anticipated working hours detailed in Table 3.7 with construction being commenced in 2021 and the commissioning of the Proposed Development estimated in 2024. A high-level programme is included in Tables 3.8 and 3.9. Further detail is provided at Appendix 3.8.

Table 3.7 - Marine and Onshore anticipated working hours

Activity	Anticipated working hours per day	Anticipated working days per week
Converter Station Area Construction	10 hour shifts, 08:00 – 18:00	6 days*
Marine Cable Installation	24 hour shifts	7 days
Onshore Cable Installation ***(including HDD-2, HDD-5 and HDD-6)***	10 hour shifts, 07:00 – 17:00	6 days*
Landfall Installation ***(including HDD-1, TJB and ORS)***	12 hour shifts	7 days
HDD-3 and HDD-4 Installation	12 to 24 hour shifts	7 days

**Day 6 is Saturday working which is typically a 5-hour shift 08:00 to 13:00.*

No working hours within this table preclude:

(a) start-up and shut down activities up to an hour either side of the core working hours; and

(b) the receipt of oversize deliveries to the site, the arrival and departure of personnel to and from the site, on-site meetings or briefings, and the use of welfare facilities and non-intrusive activities.

The following Onshore Cable Installation operations may take place outside the working hours detailed above, subject to agreement with the local planning authority:

Trenched Areas

- Section 4 – a 90 m section of the A3 London Road in Purbrook near Stakes Road.
  - 07:00 to 22:00 hours, Saturday and Sunday, for 4 weekends (may not be continuous)
- Section 5 – Havant Road near Drayton between Farlington Avenue and Eastern Road.
  - Up to 24 hour working, with the noisiest activities (road cutting/breaking and re-surfacing) avoided during hours of darkness for one weekend; or
  - 07:00 to 22:00 hours, for up to four weekends
- Section 6 – Fitzherbert Road and Sainsbury's Car Park
  - Night Works, with the noisiest activities (road cutting/breaking and re-surfacing) will be avoided during hours of darkness
- Section 8 – Eastern Road between Airport Service Road and north of Milton Common.
  - Up to 24 hour working, seven days per week for approximately 33 days. Noisiest activities (road cutting/breaking and re-surfacing) will be avoided outside the Harbourside Caravan Park during the hours of darkness.

Trenchless Areas

It's anticipated that the following areas of the Onshore Cable Installation may be subject to 24 hour working as detailed in the table above:

- Section 7 Langstone Harbour (HDD):

Kendall's Wharf and Farlington Playing Fields [HDD-3]

- Section 6/7 Farlington Railway Crossing (Trenchless):

Farlington Playing Fields and southern extent of Sainsbury's car park [HDD-4]

Table 3.8 - Indicative marine construction programme

Activity	Indicative Programme
Marine Cable Seabed Preparation	2021-2023
Marine Cable Installation (including remedial protection)	2022-2023
HDD Landfall Installation (Marine)	2021-2023

Table 3.9 - Indicative onshore construction programme

Activity	Indicative Programme
Converter Station Construction	Q3 2021 – Q1 2024
Onshore HVDC Route Construction/ Cable Installation	Q3 2021 – Q4 2023
HDD and Landfall Construction (Onshore)	Q3 2021 – Q4 2023
Converter Station Commissioning	Q4 2023 – Q2 2024

3.7.1.4. Table 3.9 above outlines the indicative programme for the construction works associated with the onshore elements of the Proposed Development.

3.7.1.5. The indicative construction programmes take account of a number of constraints. These include constraints and assumptions associated with traffic management (further detail is contained within the Traffic Management Strategy, within the Transport Assessment Document Reference 6.3.22.1), environmental considerations and public activities and events.

3.7.1.6. Environmental constraints have also been taken into consideration and will be built into the phasing of enabling and construction works for the Converter Station site and Onshore Cable Route;

- [redacted] breeding season from June-November, refer to Chapter 16 (Onshore Ecology) for further information and the conditions which will be observed.
- Plant growing season and winter wet season from August to November, at Kings Pond Meadow SINC and Denmead in Section 3, refer to Chapter 16 (Onshore Ecology) for further information,
- Wintering bird season, from October and March. Refer to Chapter 16 (Onshore Ecology) for further information on wintering birds and the conditions which will be observed.

3.7.1.7. Public activities and events that are planned in proximity to the Converter Station site and Onshore Cable Route, refer to Chapter 25 (Socio-economics) for further information, including but not limited to the following;

- School term time (as required),
- Football season,
- Coastal Waterside Marathon,
- Cowes Week,
- Great South Run,
- South Central Festival,
- Victorious Festival,

will be taken into consideration during the phasing of the of construction works along the route.

REFERENCES

Carbon Trust. (2015). *Cable Burial Risk Assessment Methodology: Guidance for the Preparation of Cable Burial Depth of Lowering Specification.* Carbon Trust .

Nemo Link. (2013). *UK Marine Environmental Statement Volume I.*

Planning Inspectorate. (2016). Advice note six: Preparation and submission of application documents.