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MONA OFFSHORE WIND PROJECT

Grid Connection and Cable Details Statement

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Image of an offshore wind farm

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Prepared by:

Mona Offshore Wind Ltd.

Prepared for:

Mona Offshore Wind Ltd.

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Glossary

Term	Meaning
Project terminology	
Applicant	Mona Offshore Wind Limited.
Mona Offshore Wind Project	The Mona Offshore Wind Project is comprised of both the generation assets and offshore and onshore transmission assets and associated activities.
Bodelwyddan National Grid Substation	This is the Point of Interconnection (POI) selected by the National Grid for the Mona Offshore Wind Project.
Inter-array cables	Cables which connect the wind turbines to each other and to the offshore substation platforms. Inter-array cables will carry the electrical current produced by the wind turbines to the offshore substation platforms.
Interconnector cables	Cables that may be required to interconnect the Offshore Substation Platforms in order to provide redundancy in the case of cable failure elsewhere.
Mona 400kV Grid Connection Cable Corridor	The corridor from the Mona onshore substation to the National Grid substation.
Mona Offshore Wind Project Boundary	The area containing all aspects of the Mona Offshore Wind Project, both offshore and onshore.
Mona Array Area	The area within which the wind turbines, foundations, inter-array cables, interconnector cables, offshore export cables and offshore substation platforms (OSPs) forming part of the Mona Offshore Wind Project will be located.
Mona Offshore Cable Corridor	The corridor located between the Mona Array Area and the landfall up to Mean High Water Springs (MHWS), in which the offshore export cables will be located.
Mona Onshore Development Area	The area in which the landfall, onshore cable corridor, onshore substation, mitigation areas, temporary construction facilities (such as access roads and construction compounds), and the connection to National Grid infrastructure will be located
Other terminology	
Wind turbines	The wind turbine generators, including the tower, nacelle and rotor.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for one or more Nationally Significant Infrastructure Project (NSIP).
Intertidal area	The area between Mean High Water Springs (MHWS) and Mean Low Water Springs (MLWS).
Landfall	The area in which the offshore export cables make contact with land and the transitional area where the offshore cabling connects to the onshore cabling.
Maximum Design Scenario (MDS)	The scenario within the design envelope with the potential to result in the greatest impact on a particular topic receptor, and therefore the one that should be assessed for that topic receptor.
Offshore Substation Platform (OSP)	The offshore substation platforms located within the Mona Array Area will transform the electricity generated by the wind turbines to a higher voltage allowing the power to be efficiently transmitted to shore.

Acronyms

Acronym	Description
CION	Connection and Infrastructure Operations Note
DCO	Development Consent Order
EnBW	Baden-Württemberg AG
ES	Environmental Statement
EWG	Expert Working Group
FOC	Fibre Optic Cable
HDD	Horizontal Directional Drill
HND	Holistic Network Design
HVAC	High Voltage Alternating Current
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
NGESO	National Grid Electricity System Operator
OSP	Offshore Substation Platform
OTNR	Offshore Transmission Network Review
PEIR	Preliminary Environmental Information Report
TJB	Transition Joint Bay

Units

Unit	Description
km	Kilometres
kV	Kilovolts
m	Metre
m^2	Metres square
MW	Megawatt

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1 Summary

1.1.1.1 This document is submitted on behalf of Mona Offshore Wind Limited (the Applicant), a joint venture of bp Alternative Energy Investments Ltd (hereafter referred to as bp) and Baden-Württemberg AG (hereafter referred to as EnBW) in support of its application to construct, operate and decommission the Mona Offshore Wind Project.

1.1.1.2 The electrical connection works for Mona Offshore Wind Project will comprise offshore and onshore export cables comprising up to four cable circuits, transition joint bays (TJBs) at landfall, joint bays and link boxes along the onshore cable route, an onshore substation and connection to the National Grid at Bodelwyddan (the transmission works). The identified export cable corridors are approximately 90 km offshore and 15 km onshore. The transmission network for Mona Offshore Wind Project will use High Voltage Alternating Current (HVAC) technology.

1.1.1.3 The generation works will consist of the construction of up to 96 wind turbines, inter-array cabling, up to four offshore substation platforms (OSP) and related works.

1.1.1.4 The maximum system voltages for the cables will be as follows:

- Inter-array and interconnector cables – up to 132 kV
- Offshore export cables – up to 275 kV
- Onshore export cables – up to 275 kV
- 400 kV grid connection cables.

2 INTRODUCTION

2.1 Overview

2.1.1.1 This Grid Connection and Cable Details Statement (this Statement) is submitted on behalf of the Applicant and relates to its proposal to construct and operate Mona Offshore Wind Project (Figure 2-1). Mona Offshore Wind Project is located within Welsh waters approximately 30 km from the north coast of Wales. Mona Offshore Wind Project will have an installed capacity of over 350 MW.

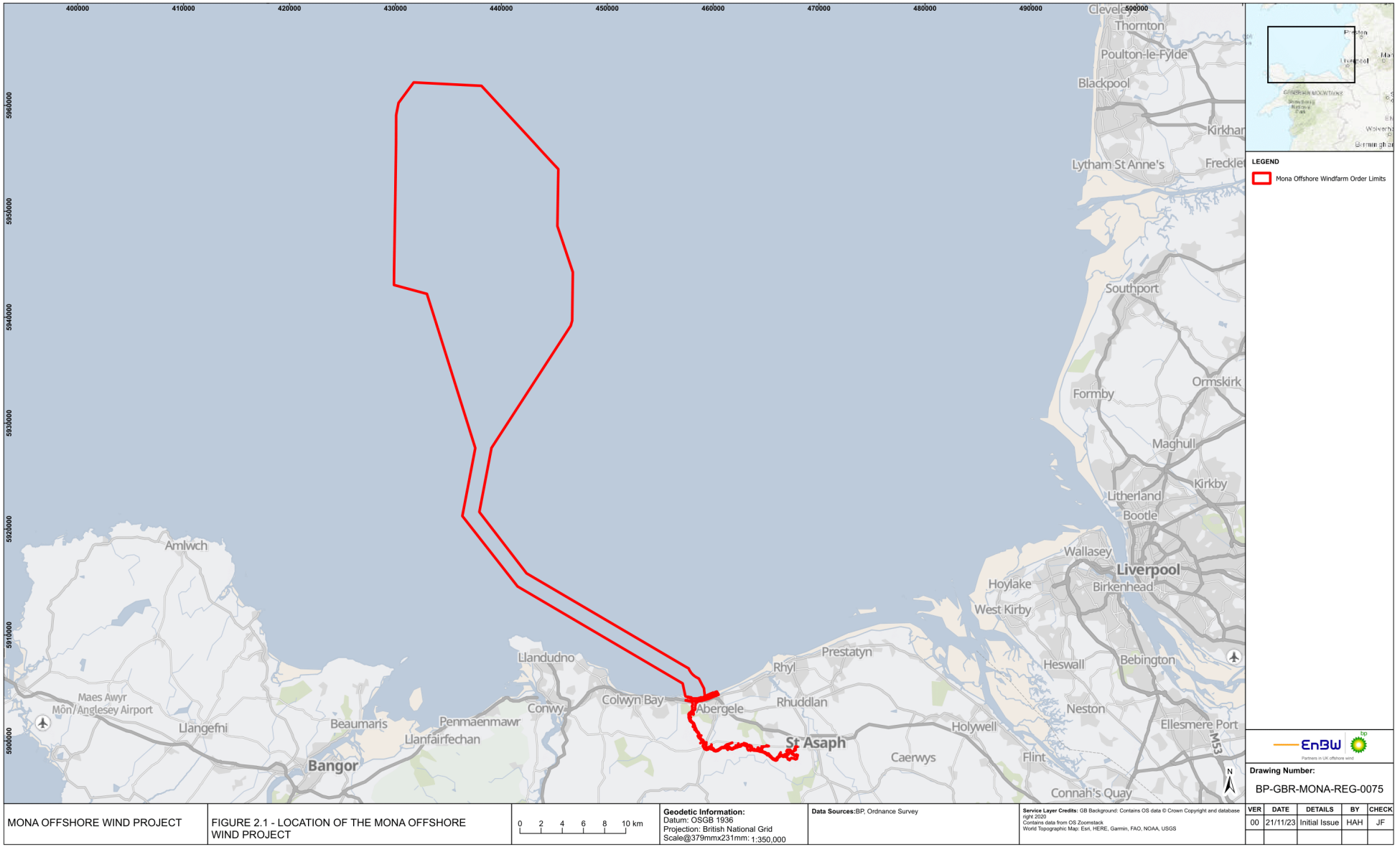

Figure 2-1: Location of the Mona Offshore Wind Project

2.1.1.2 This Statement has been prepared in accordance with Regulation 6(1)(b)(i) of the Infrastructure Planning (Applications: Prescribed Forms and Procedures) Regulations 2009 (the APFP Regulations) which requires the Applicant to provide "*details of the proposed route and method of installation for any cable*" as part of its application for a development consent order in respect of Mona Offshore Wind Project.

2.1.1.3 This Statement provides a summary of the relevant information contained within the Environmental Statement (ES) (Document Reference F1.1 *et seq)* and, where appropriate, reference to the relevant chapters of the ES is provided.

2.1.1.4 The Mona Array Area will cover approximalety 300 km² with an offshore cable corridor running south then east from the array area to the landfall at Llandulas, North Wales (see Figure 2.1)

2.1.1.5 The offshore export cables will connect to the onshore cables in TJBs to the south of the A547. From there the onshore cables will connect to the Mona onshore substation located to the south of the Bodelwyddan National Grid Substation and from the onshore substation to the existing National Grid substation at Bodelwyddan in Denbighshire. The onshore cable route will have a length of approximately 15 km and the onshore export cables will be buried between the landfall and the National Grid substation.

2.1.1.6 The Mona Offshore Wind Project Development Consent Order (DCO) will, among other works, authorise the construction, operation, maintenance and decommissioning of the following infrastructure:

- Wind turbines and foundations
- OPSs and foundations
- Inter-array cables
- Interconnector cables
- Export cables (onshore and offshore)
- Cable crossings
- TJBs
- Cable link boxes
- The Mona onshore substation
- 400 kV cables connecting into the National Grid substation
- Installation of 44 kV switchgear at the National Grid substation to connect the Mona Offshore Wind Project.

2.1.1.7 An HVAC export cable solution has been chosen for the Mona Offshore Wind Project as it is an efficient solution both in terms of minimising electrical losses and in minimising the size and amount of infrastructure required.

2.1.1.8 The development of the Mona Offshore Wind Project has been shaped by extensive engagement with a wide range of stakeholders, landowners and people with interests in the land, together with input from a range of technical disciplines, including electrical, engineering, heritage, human environment, ecological and socio-economic appraisal studies. Further detail is provided in the Consultation Report (Document Reference E3).

2.1.1.9 Chapter 4: Site selection and consideration of alternatives of the ES (Document Reference F1.4) sets out the approach taken to identifying the most appropriate

location for the Mona Offshore Wind Project transmission works and refining the project design.

2.2 Selection of the point of interconnection

2.2.1.1 Until 2021, National Grid Electricity System Operator (NGESO) used the Connection and Infrastructure Operations Note (CION) process to coordinate changes needed to the electricity network to accommodate new offshore connections from offshore energy infrastructure.

2.2.1.2 In its 2020 report to parliament, the Climate Change Committee called for government to develop a strategy to coordinate interconnectors and offshore networks for wind farms and their connections to the onshore network and bring forward any legislation necessary to enable coordination (Climate Change Committee, 2020). Following this, the UK government announced the Offshore Transmission Network Review (OTNR) to ensure that the transmission connections for offshore wind generation are delivered in the most appropriate way.

2.2.1.3 The output of the OTNR was the Holistic Network Design (HND); an integrated approach for connecting new offshore wind infrastructure to the grid cohesively (NGESO, 2022).

2.2.1.4 Mona Offshore Wind Project was scoped into the HND as a Pathway to 2030 Project. The recommended design for the Northwest Region (within which the Mona Offshore Wind Project is located) put forward by NGESO is a combination of collaborative developer-led solutions and single radial connections.

2.2.1.5 A number of potential grid connection locations and options were considered by NGESO through the HND process based on an understanding of the grid infrastructure capacity in relation to the location of the Mona Offshore Wind Project (and considering other Round 4 offshore wind projects coming forwards in the Irish Sea). During the early stages of the site selection process for the Mona Offshore Wind Project the Applicant considered all possible grid connection options to avoid pre-empting the HND process.

2.2.1.6 NGESO concluded that the preferred connection option representing the most optimal design (economic, efficient and co-ordinated) considering all criteria (i.e. technical, cost, environmental and deliverability) for the Mona Offshore Wind Project was a single radial grid connection into an extension of the existing Bodelwyddan Substation in Denbighshire, North Wales.

2.2.1.7 The Mona Offshore Wind Project will rely on an extension of the existing Bodelwyddan National Grid Substation. This work will be undertaken by National Grid to facilitate the connection of the Mona Offshore Wind Project and other possible future projects. Works for the National Grid substation extension are not included within the Mona Offshore Wind Project DCO application as they will be consented separately by National Grid.

3 PROPOSED OFFSHORE WORKS

3.1 Overview

3.1.1.1 Identification of the Mona Array Area was the first of multiple stages in the site selection and alternatives process. The initial boundary for the Mona Offshore Wind Project was identified as part of The Crown Estate's Offshore Wind Leasing Round 4. The array area has been refined throughout the iterative design process.

3.1.1.2 Following initial identification of the array area and National Grid's confirmation that the preferred point of interconnection for the Mona Offshore Wind Project was the Bodelwyddan National Grid Substation in Denbighshire (see section 2.2), the process of selecting the location of project infrastructure commenced. For the offshore cable route, this involved an assessment of a long list of identified options against the 2017 Crown Estate 'Cable Route Protocol' and design principles set by the Applicant. These design principles had regard to environmental constraints and sought to minimise environmental effects balanced with costs and deliverability. The long list was analysed for constraints and engineering feasibility to identify a shortlist of suitable options. From the short list a preferred offshore cable route was selected. The selected offshore cable route was subject to statutory consultation as part of the overall Mona Offshore Wind Project. Further detail on this process is provided in Chapter 4: Site selection and consideration of alternatives of the ES (Document Reference F1.4).

3.1.1.3 The offshore generation and transmission infrastructure for the Mona Offshore Wind Project includes:

- up to 96 wind turbines
- up to four OSP
- inter-array cables with a total length of up to 325 km
- up to 50 km of interconnectors cables
- up to four offshore export cables each approximately 90 km in length.

3.2 Inter-array cables

3.2.1.1 Cables carrying the electrical current generated by wind turbines will link the wind turbines together and on to an OSP. A small number of turbines are typically grouped together on a cable 'string' that connects those turbines to an OSP. The wind farm array will contain several of these strings.

3.2.1.2 The inter-array cables will consist of a number of conductor cores, usually made from copper or aluminium. These will be surrounded by layers of insulating material as well as material to armour the cable from external damage and to keep the cable watertight.

3.3 Interconnector cables

3.3.1.1 The Project may use up to three interconnector cables to link together the OSPs in the array area. These interconnector cables provide an electrical and communications link between the substations in the event of an export cable failure.

3.3.1.2 The interconnector cables will consist of a number of conductor cores, usually made from copper or aluminium. These will be surrounded by layers of insulating material as well as material to armour the cable from external damage and to keep the cable watertight.

3.4 Offshore export cables

3.4.1.1 The offshore export cables are typically larger in diameter than the inter-array cables as they contain larger cores to transmit greater power. Like the inter-array cables, the offshore export cables will consist of a number of cores, usually made from copper or aluminium, surrounded by layers of insulation material and armour to protect the cable from external damage.

3.5 Installation

3.5.1.1 Following the completion of all pre-construction activities, including satisfying pre-construction statutory consent conditions, engineering, design and procurement and detailed site surveys, seabed preparation is one of the first elements of the offshore construction process for the inter-array, interconnector and offshore export cables. Requirements for seabed preparation will vary according to the specific ground conditions and the type of infrastructure being installed. Detailed geophysical surveys will be carried out pre-construction to provide further detail and to clarify the presence of boulders, sandwaves, unexploded ordnance (UXO) and other obstructions on the seabed.

3.5.1.2 Following the completion of the relevant seabed preparation works the inter-array, interconnector and offshore export cables will be installed. Possible installation methods for the offshore cables include:

- Simultaneous lay and burial via ploughing, cutting or jetting
- Post-lay burial via cutting, jetting, ploughing, mass flow excavation or dredging
- Cable installation following pre-lay ploughing, cutting or trenching.

3.6 Cable protection

3.6.1.1 In some cases where the minimum cable burial depth cannot be achieved, or where it is necessary to cross an existing cable, it will be necessary to use alternative methods to protect the cable from external damage. This could involve rock placement, concrete mattresses or other solutions such as cable protection systems or protective aprons. Cable burial is the preferred method of installation, and additional cable protection will only be used as a contingency where cable burial is not appropriate or achievable.

4 LANDFALL

4.1 Overview

4.1.1.1 As part of a holistic site selection process the development of the chosen landfall location took place alongside the development of the offshore cable route and took into account a number of additional considerations including the location of designated conservation sites. Refinement of the landfall location was undertaken throughout the iterative design process including by applying a constraints analysis to the identified options and considering consultation feedback before the final landfall location was identified. Further detail on this process is provided in Chapter 4: Site selection and consideration of alternatives of the ES (Document Reference F1.4).

4.1.1.2 The offshore cables will make landfall at Llandulas, with associated landfall infrastructure, including the TJBs, in an area to the south of the A547.

4.1.1.3 The works at the landfall include the following:

- Construction of TJBs
- Welding of cable ducts
- Trenchless techniques for the installation of the cable conduits under the intertidal zone between the TJBs to a point beyond Mean Low Water Springs (MLWS)
- Installation of offshore export cables (cable pulling)
- Installation of and jointing of offshore export cables to the onshore export cables
- Backfilling and reinstatement works.

4.1.1.4 There will be up to four cable conduits at landfall which will be laid at an indicative maximum 30 m depth.

4.2 Transition Joint Bays

4.2.1.1 A maximum of four circuits will be required and each circuit will require a TJB and link box, with a maximum footprint of 300 m^2 per TJB. The indicative maximum depth of the TJB will 4 m. Land above the TJBs will be reinstated, an inspection cover will be provided on the surface for link boxes for access during the operations and maintenance phase.

4.3 Installation

4.3.1.1 A trenchless technique will be used to install conduits which will house the cables under the Grade II listed building (Gwrych Estate Boundary Wall from Tan-yr-Ogof to Gwrych Lodge), the A547, the A55 North Wales Expressway, the Network Rail railway line, the historic landfill, the coastal footpath, sea defences and the beach. The conduits will run from the TJBs in a northly direction to exit pits located in the shallow subtidal area. The offshore export cables will be pulled ashore through these pre-installed conduits and will interface with the onshore cables at the TJBs.

4.3.1.2 Possible trenchless installation techniques at landfall include:

- Horizontal Directional Drilling (HDD)
- Thrust boring
- Micro tunnelling

5 PROPOSED ONSHORE WORKS

5.1 Onshore cables

5.1.1.1 The onshore export cable corridor is approximately 15 km running generally in a northwest to southeast direction.

5.1.1.2 Up to four High Voltage Alternating Current (HVAC) circuits will be required to transmit the power from the TJBs to the onshore substation. The cable circuits will be installed within the onshore export cable corridor. The working width within the onshore export cable corridor during construction will generally be 74 m, expanding to 100 m at trenchless crossing locations and 300 m wide at Gwrych Wood to account for potential areas of historic mining activity. Each cable circuit will consist of three cables as well as up to two Fibre Optic Cables (FOCs). The cables will be installed in individual lengths varying from approximately 750 m to 1750 m and then jointed. The FOCs may be installed in longer sections.

5.1.1.3 There will also be up to 80 joint bays and 80 link boxes along the length of the onshore export cable corridor. Joint bays are typically concrete lined pits, that provide a clean and dry environment for jointing sections of cable together. Link boxes are smaller pits compared to joint bays, which house connections between the cable shielding, joints for FOCs and other auxiliary equipment. Land above the joint bays will be reinstated, an inspection cover will be provided on the surface for link boxes for access during the operations and maintenance phase.

5.2 Cable installation

5.2.1.1 The cables will be installed in one trench per circuit (maximum of four trenches for up to four circuits), with each trench up to 2.5 m wide and up to 2 m deep (although this depth could increase where trenchless techniques are used to cross obstacles or potentially decrease where there are engineering limitations e.g. shallow bed rock). The indicative target burial depth is 1.2 m (to top of the duct) and the indicative minimum burial depth is 0.90 m (to top of duct).

5.2.1.2 The main cable installation method will be through the use of open-cut trenching with High Density Polyethylene ducts installed, the trench backfilled and cables pulled through the pre-laid ducts from one jointing bay to another.

5.2.1.3 Trenchless crossing techniques, for example HDD, will be used in certain specific locations to cross certain environmental and physical features such as main rivers, major drains, roads and railways.

5.2.1.4 Following the installation of all cables and joint pits and the completion of testing and commissioning, the construction working width will be cleared and reinstated in accordance with the Code of Construction Practice (Document reference J26). Further details can be found in Chapter 3: Project description of the ES (Document Reference F1.3).

6 ONSHORE SUBSTATION TO THE NATIONAL GRID SUBSTATION

6.1.1.1 One onshore project substation (HVAC) will be required for the Mona Offshore Wind Project transform the power supplied by the Mona Offshore Wind Project to 400 kV and to adjust to the quality and power factor, as required to meet the UK Grid Code for supply to the National Grid. The onshore substation will contain a number of elements including switchgear, busbars, transformers, capacitors, reactors, reactive power compensation equipment, filters, cooling equipment, control and welfare buildings, lightning protection rods (if required) and internal road access.

6.1.1.2 The guiding principles for locating the onshore substation are to achieve an economic and efficient connection (i.e. as close as possible to the point of interconnection) whilst taking into account environmental constraints including siting principles in National Grid's Horlock Rules (National Grid Company, n.d.). An Area of Search for the onshore substation was broadly defined as a 5 km buffer around the point of interconnection (Bodelwyddan National Grid Substation). A number of zones were identified within the area of search which were later refined through consultation with the site selection EWG to two preferred zone that were presented in the Preliminary Environmental Information Report (PEIR). Following statutory consultation, the preferred zone was selected and refined to the onshore substation footprint for the basis of the DCO application.

6.1.1.3 A further section of buried cable (400 kV grid connection cables) will be required to connect the onshore substation to Bodelwyddan National Grid Substation. The 400 kV grid connection cables will run northwards from the onshore substation to connect to the Bodelwyddan National Grid Substation. Up to two 400 kV HVAC circuits will be required. The 400 kV grid connection cables will be installed in a similar manner to the onshore export cables (see section 5).

7 REFERENCES

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