Neart na Gaoithe

Neart na Gaoithe Offshore Wind Farm

Cable Plan – Offshore Transmission Infrastructure

June 2026

Rev 1.0

DOCUMENT REFERENCE: NNG-NNG-ECF-PLN-0019

Neart na Gaoithe Offshore Wind Farm

Offshore Transmission Infrastructure Cable Plan

Pursuant to the OfTI Marine Licence Condition 3.2.2.8

For the approval of the Scottish Ministers

SIGN OFF		
Name (Role)	Signature	Date
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Plan Overview

Purpose and Objectives of the Plan

This Offshore Transmission Infrastructure (OfTI) Cable Plan (CaP) has been prepared to address the specific requirements of the relevant conditions attached to the OfTI Marine Licence issued to Neart na Gaoithe Offshore Wind Limited (NnGOWL).

This CaP confirms the location of the export cables and their method of burial and protection. It explains how cable routing has been informed by survey work that has identified constraints within the Project area. This CaP also confirms the technical specification of the export cables.

The OfTI, namely the two Offshore Substations Platforms (OSPs) and export cables, will be divested to an Offshore Transmission Operator (OfTO). NnGOWL will remain responsible for the OfTI up to the point of transfer to the OfTO. Upon transfer of ownership, the OfTO will be responsible for updating and implementing the relevant elements of this OfTI CaP.

All NnGOWL personnel and Contractors involved in the Project must comply with this CaP, up to the point of transfer to an OfTO. A separate CaP (NNG-NNG-ECF-PLN-0007) has been prepared for the Generating Station cable assets, namely the inter-array cables and interconnector cable.

Scope of the Plan

The CaP covers, in line with the requirements of the consents conditions, and in line with industry standards and good practice, the following for the export cables:

- Installation methods;
- Routing;
- Technical specifications and an assessment of the attenuation of electro-magnetic fields;
- A summary of the cable burial risk assessments that have been undertaken to inform burial and protection plans; and
- Methodologies for surveys of the cables through the operational life of the Project.

Structure of the Plan

The CaP is structured as follows:

Sections 1 to 3 sets out the scope and objectives of the CaP, statements of compliance and provide an overview of the Project.

Section 4 confirms cable location and layout.

Section 5 details the technical specification of the cables and associated electromagnetic fields.

Sections 6 and 7 set out intended cable burial and protection, as informed by cable burial risk assessments.

Section 8 identifies cable inspection activities to be undertaken during the operational phase of the Project.

Section 9 confirms compliance with the Application.

Plan Audience

The CaP is intended to be referred to by personnel involved in the construction and operation and maintenance of the Project, including NnGOWL personnel and Contractors, up to the point of transfer to the OFTO.

Compliance with this CaP will be monitored by the NnGOWL Consents team, NnGOWL's Environmental Clerk of Works (ECoW) and the Marine Scotland Licensing Operations Team (MD-LOT), up to the point of transfer to the OFTO. Upon transfer of ownership, the OfTO will be responsible for updating and monitoring compliance with the OfTI CaP.

Plan Locations

Copies of this CaP are held in the following locations during operation and maintenance:

- NnGOWL Project Office;
- At the premises of any contractors undertaking licensed activities on behalf of NnGOWL;
- NnGOWL Operational Control Centre; and
- With NnGOWL's Offshore Environmental Manager.

The OfTI CaP will be held to by the NnGOWL O&M team up to the point of transfer, upon transfer of ownership the OfTO will be responsible for storing and updating the OfTW OMP as required.

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Acronyms and Abbreviations

TERM	DESCRIPTION
AC	Alternating Current
AEZ	Archaeological Exclusion Zone
AGDS	Acoustic Ground Discrimination System
AHT	Anchor Handling Tug
AIS	Automatic Information System
CBRA	Cable Burial Risk Assessment
CLV	Cable Lay Vessel
CPS	Cable Protection System
CPT	Cone Penetration Test
CTV	Crew Transfer Vessels
DDM	Degrees Decimal Minutes
DGC	Defence Geographic Centre
DoL	Depth of Lowering
DP	Dynamic Positioning
DSV	Dive Support Vessel
DTS	Distributed Temperature Sensing
ECoW	Environmental Clerk of Works
EIA	Environmental Impact Assessment
EMF	Electromagnetic fields
ES	Environmental Statement
FLOWW	Fishing Liaison with Offshore Wind and Wet Renewables Group
GPS	Geographical Positioning System
HDD	Horizontal Directional Drilling
HDPE	High-Density Polyethylene

TERM	DESCRIPTION
HVAC	High Voltage Alternating Current
ICES	International Council for the Exploration of the Sea
IEC	International Electrotechnical Commission
KP	Kilometre Point
kV	Kilo Volt
LAT	Lowest Astronomical Tide
MBES	Multi Beam Echosounder
MCA	Maritime and Coastguard Agency
MHWS	Mean High Water Springs
MLWS	Mean Low Water Springs
MMO	Marine Management Organization
MSBL	Mean Seabed Level
MD-LOT	Marine Directorate Licensing Operations Team
NnGOWL	Neart na Gaoithe Offshore Wind Limited
NtM	Notice to Mariners
OfTI	Offshore Transmission Infrastructure
OfTO	Offshore Transmission Operator
OSP	Offshore Substation Platforms
OSV	Offshore Support Vessel
O&M	Operation and Maintenance
PLGR	Pre-Lay Grapnel Run
ROV	Remote Operated Vehicle
SFF	Scottish Fishermen’s Federation
SNH	Scottish Natural Heritage (now known as Nature Scot)
SSS	Sidescan Sonar

TERM	DESCRIPTION
TAR	Transportation Audit Report
TJB	Transition Joint Bay
UKHO	UK Hydrographic Office
WTW	Walk to Work
XLPE	Cross Linked Polyethylene

Defined Terms

TERM	DESCRIPTION
Addendum	The Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018.
Application	The Environmental Impact Assessment Report, Habitats Regulations Appraisal Report and supporting documents submitted to the Scottish Ministers by NnGOWL on 16 March 2018; the Addendum of Additional Information submitted to the Scottish Ministers by NnGOWL on 26 July 2018 and the Section 36 Consent Variation Report dated 08 January 2019.
Company	Neart na Gaoithe Offshore Wind Limited (NnGOWL) (Company Number SC356223). NnGOWL has been established to develop, finance, construct, operate, maintain and decommission the Project.
Consent Conditions	The terms that are imposed on the Company under the Offshore Consents that must be complied with.
Consent Plans	The plans, programmes or strategies required to be approved by the Scottish Ministers (in consultation with appropriate stakeholders) in order to discharge the Consent Conditions.
Contractors	Any Contractor/Supplier (individual or firm) working on the Project, hired by NnGOWL.
EIA Report	The Environmental Impact Assessment Report, dated March 2018, submitted to the Scottish Ministers by NnGOWL as part of the Application.
Inter-array Cables	The offshore cables connecting the wind turbines to one another and to the offshore substation platforms (OSPs).
Interconnector Cables	The offshore cables connecting the OSPs to one another.
Generating Station Marine Licence	The written consent granted by the Scottish Ministers under the Marine (Scotland) Act 2010, for construction works and deposits of substances or objects in the Scottish Marine Area in relation to the Generating Station (Licence Number MS-00011510), dated the 15 December 2025.

TERM	DESCRIPTION
Offshore Transmission Works (OfTW) Marine Licence	The written consent granted by the Scottish Ministers under the Marine (Scotland) Act 2010, for construction works and deposits of substances or objects in the Scottish Marine Area in relation to the OfTW (Licence Number MS-00011509), dated the 15 December 2025.
Offshore Consents	The Section 36 Consent and the OfTW and Generating Station Marine Licences.
Offshore Export Cable Corridor	The area within which the Offshore Export Cables are to be located, including the Extension Area approximately 9 km offshore from the landfall location, and specified within the varied OfTW Marine Licence (Licence Number MS-00008954).
Offshore Export Cable Corridor Extension Area	The area within which short sections of the offshore export cables are to be located (around KP9 of the Offshore Export Cable Corridor) in order to avoid an obstruction within the originally consented corridor that forms part of the OfTW Area. Following issue of the varied marine licence (Licence Number MS-00008954) the Extension Area has been incorporated into the consented Offshore Export Cable Corridor.
Offshore Export Cables	The Offshore Export Cables connecting the OSPs to the landfall site.
OfTI	The Offshore Transmission Infrastructure comprising the OSPs and Offshore Export Cables required to connect the Wind Farm to the Onshore Transmission Infrastructure at the landfall.
OfTI Area	The area outlined in red and blue in Figure 1 attached to Part 4 of the OfTW Marine Licence.
OnTW	The onshore transmission works from landfall and above Mean High Water Springs (MHWS), consisting of onshore export cables and the onshore substation.
Project	The Wind Farm and the OfTI.
Section 36 Consent	The written consent granted on 3 December 2018 by the Scottish Ministers under Section 36 of The Electricity Act 1989 to construct and operate the Wind Farm, as varied by the Scottish Ministers under section 36C of the Electricity Act 1989 on 4 June 2019.
Section 36 Consent Variation Report	The Section 36 Consent Variation Report submitted to the Scottish Ministers by NnGOWL as part of the Application as defined above on 08 January 2019.
Subcontractors	Any Contractor/Supplier (individual or firm) providing services to the Project, hired by the Contractors (not NnGOWL).
Wind Farm	The offshore array as assessed in the Application including wind turbines, their foundations and inter-array cabling and interconnector cables.
Wind Farm Area	The area outlined in black in Figure 1 attached to the Section 36 Consent Annex 1, and the area outlined in red in Figure 1 attached to Part 4 of the Wind Farm Marine Licence.

Consent Plans

CONSENT PLAN	ABBREVIATION	DOCUMENT REFERENCE NUMBER
Decommissioning Programme	DP	NNG-NNG-ECF-PLN-0016
Construction Programme and Construction Method Statement	CoP & CMS	NNG-NNG-ECF-PLN-0002
Piling Strategy	PS	NNG-NNG-ECF-PLN-0011
Development Specification and Layout Plan	DSLP	NNG-NNG-ECF-PLN-0003
Design Statement	DS	NNG-NNG-ECF-PLN-0004
OfTI Environmental Management Plan	EMP	NNG-NNG-ECF-PLN-0018
OfTI Operation and Maintenance Programme	OMP	NNG-NNG-ECF-PLN-0017
OfTI Navigational Safety and Vessel Management Plan	NSVMP	NNG-NNG-ECF-PLN-0021
Emergency Response Cooperation Plan	ERCoP	NNG-NNG-ECF-PLN-0015
OfTI Cable Plan	CaP	NNG-NNG-ECF-PLN-0019
OfTI Lighting and Marking Plan	LMP	NNG-NNG-ECF-PLN-0020
Project Environmental Monitoring Programme	PEMP	NNG-NNG-ECF-PLN-0013
Fisheries Management and Mitigation Strategy	FMMS	NNG-NNG-ECF-PLN-0008
Written Scheme of Investigation and Protocol for Archaeological Discoveries	WSI & PAD	NNG-NNG-ECF-PLN-0005
Construction Traffic Management Plan	CTMP	NNG-NNG-ECF-PLN-0014

1 Introduction

1.1 Background

1. The Project is being developed by Neart na Gaoithe Offshore Wind Limited (NnGOWL), which is owned by EDF Power Solutions UK and Ireland (referred to as EDF throughout the remainder of this document).
2. NnGOWL are responsible in undertaking the operation and maintenance of the OfTI assets up to the point of transfer of the assets to an Offshore Transmission Owner (OfTO), thereafter the OfTO will be responsible for the above for the OfTI.
3. The OfTI consent is the Transmission Works Marine Licence, originally MS-00008954 on the 12 October 2020 and most recently on the 15 December 2025 by issue of MS-00011509.
4. A separate CaP has been prepared for the Generating Station assets, namely the inter-array cables and interconnector cable.

1.2 Objectives of this Document

1. The OfTI Marine Licence contains a variety of conditions that must be discharged through approval by the Scottish Ministers prior to the commencement of any offshore construction works.
2. One such requirement is the approval of a CaP. The relevant conditions setting out the requirement for a CaP for approval, and which are to be discharged by this CaP, are presented in full in Table 1-1.

Table 1-1: CaP consent conditions to be discharged by this Consent Plan

OFFSHORE CONSENTS REFERENCE	CONDITION	WHERE ADDRESSED
OfTI Marine Licence Condition 3.2.2.8	The Licensee must, no later than six months prior to the Commencement of the Licensed Activity, submit a CaP, in writing, to the Licensing Authority for its written approval.	This document sets out the CaP for approval by the Scottish Ministers
	Such approval may only be granted following consultation by the Licensing Authority with SNH[1], MCA, Scottish Fishermen's Federation ("SFF") and any such other advisors or organisations as may be required at the discretion of the Licensing Authority. Commencement of the Licensed Activity may not take place until such approval is granted. The CaP must be in accordance with the Application.	Consultation to be undertaken by the Scottish Ministers.
	The CaP must include, but not be limited to, the following: a. The vessel types, location, duration and cable laying techniques for the export cables;	Section 4, 5 and 6
	b. The results of monitoring or data collection work (including geophysical, geotechnical and benthic surveys) which will help inform cable routing;	Section 4.2

[1] Scottish Natural Heritage (SNH) was rebranded to NatureScot on 24 August 2020.

OFFSHORE CONSENTS REFERENCE	CONDITION	WHERE ADDRESSED
	c. Technical specification of export cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding;	Section **Error! Reference source not found.**
	d. A burial risk assessment to ascertain burial depths and where necessary alternative protection measures;	Section 6
	e. Methodologies for surveys (e.g. over trawl) of the export cables through the operational life of the wind farm where mechanical protection of cables laid on the seabed is deployed; and	Section 8.1
	f. Methodologies for cable inspection with measures to address and report to the Licensing Authority any exposure of export cables.	Section 8.2
	Any licensed cable protection must ensure existing and future safe navigation is not compromised. The Licensing Authority will accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum. Any greater reduction in depth must be agreed in writing by the Licensing Authority.	Section 8.3

1.3 Linkages with Other Consent Plans

3. This CaP sets out the export cable arrangements and the methods for installation, operation and maintenance. It forms part of a suite of approved documents that will provide the framework for the operational phase of the wind farm – namely the other Consent Plans required under the OfTW Marine Licence.

4. The consent conditions that require the development of a CaP do not explicitly identify linkages between this and other Consent Plans. However, other conditions require that several other Consent Plans be consistent with the CaP; these plans are identified in Table 1-2.

Table 1-2: CaP linkages with other Consent Plans

OFFSHORE CONSENT REFERENCE	CONSENT PLAN	CONSISTENCY WITH AND LINKAGE TO CAP
OfTW Marine Licence Condition 3.2.2.7	**The Construction Method Statement (CMS)**	The purpose of the approved CMS is to detail the methods that will be implemented during the construction of the Project. The CMS must, so far as is reasonably practicable, be consistent with the CaP.
OfTW Marine Licence Condition 3.2.2.16	**Operation and Maintenance Programme (OMP)**	The OMP will set out the procedures and good working practices for the operational and maintenance (O&M) phase of the Project.

1.4 CaP Document Structure

5. In response to the specific requirements of the OfTW Marine Licence, this CaP has been structured so as to be clear that each part of the specific requirements have been met and that the relevant

information to allow the Scottish Ministers to approve the CaP has been provided. The document structure is set out in Table 1-3.

Table 1-3: CaP document structure

SECTION	TITLE	OVERVIEW
1	Introduction	Background to consent requirements and overview of the CaP scope and structure; and Identifies those other Consent Plans with linkages to the CaP.
2	NnGOWL Statements of Compliance	Sets out the NnGOWL statements of compliance in relation to the CaP.
3	Project Overview	Provides an overview of the Project.
4	Location and Layout of Cables	Provides information on the cable routing and relevant key constraints considered.
5	Technical Specification of Cables	Sets out the technical specification of the cables.
6	Cable Burial	Summarises the Cable Burial Risk Assessments (CBRA) undertaken and confirms proposed burial depth of cables.
7	Cable Installation Method	Describes the method of cable installation.
8	Operation and Maintenance	Sets out the approach to cable inspections following installation.
9	Compliance with the Application	Confirms that the details set out in this CaP are in accordance with those assessed in the Application.

2 NnGOWL Statements of Compliance

6. NnGOWL (including NnGOWL's relevant Contractors/Subcontractors) in undertaking the operation of the Project will comply with this CaP as approved by the Scottish Ministers, until such time as the transfer of the OfTI assets to an OfTO.
7. Where updates or amendments are required to this CaP, NnGOWL will ensure the Scottish Ministers are informed as soon as reasonably practicable and where necessary the CaP will be resubmitted for approval, until such time as the transfer of the OfTI assets to the OfTO.
8. NnGOWL will comply with the limits defined by the Application and supporting documentation (referred to in Part 2 of the OfTW Marine Licence in so far as they apply to this CaP (unless otherwise approved in advance by the Scottish Ministers), until such time as the transfer of the OfTI assets to the OfTO.

3 Project Overview

9. The Wind Farm Area is located to the northeast of the Firth of Forth, 15.5 km directly east of Fife Ness on the east coast of Scotland (See Figure 3-1). The Wind Farm Area covers approximately 105 km^2. Offshore Export Cables will be located within the Offshore Export Cable Corridor which runs in an approximately southwest direction from the Wind Farm Area, making landfall at Thorntonloch beach to the south of Torness Power Station in East Lothian. The Offshore Export Cable Corridor is generally 300 m in width from the Wind Farm Area boundary to the landfall location with a slightly wider area at approximately 9 km offshore from Thorntonloch beach associated with the Extension Area. Figure 3-1 shows the Wind Farm Area and Offshore Export Cable Corridor (including the Extension Area).

10. Offshore Consents allow for the construction and operation of the following main components Generating Station and OfTI, which together comprise the Project.

11. The Generating Station is comprised of:
    - 54 wind turbines generating a maximum total output of around 450 MW;
    - 54 jacket substructures installed on pre-piled foundations, to support the wind turbines;
    - A network of inter-array subsea cables, buried and/or mechanically protected, to connect strings of turbines together and to connect the turbines to the OSPs;
    - One interconnector cable connecting the OSPs to each other; and
    - Minor ancillary works such as the deployment of metocean buoys and permanent navigational marks.

12. The components that make up the OfTI, and covered by this CaP, consist of the following:
    - Two alternating current (AC) substation platforms, referred to as Offshore Substation Platforms (OSPs), to collect the generated electricity and transform the electricity from 66 kV to 220 kV (kilo Volt) for transmission to shore;
    - Two jacket substructures installed on piled foundations, to support the OSPs; and
    - Two buried and/or mechanically protected subsea export cables to transmit the electricity from the OSPs to the landfall at Thorntonloch and connecting to the onshore buried export cables for transmission to the onshore substation and connection to the National Grid network; and
    - Minor ancillary works such as such as J-tubes and access facilities.

13. Offshore construction commenced in August 2020 and was completed in February 2026. Details of the construction programme are provided in the Construction Programme and Construction Method Statement (CoP and CMS).

14. Procedures and good working practices for operation and maintenance are set out in the Operation and Maintenance Programme.

15. The OfTI, namely the two Offshore Substations Platforms (OSPs) and export cables, will be sold to an Offshore Transmission Operator (OfTO). NnGOWL will remain responsible for the O&M of the OfTI up to the point of transfer to the OfTO.

16. Until transfer of ownership, the NnGOWL will be responsible for updating and implementing the relevant elements of this CaP, as well as OfTI assets for which a separate CaP has been prepared.

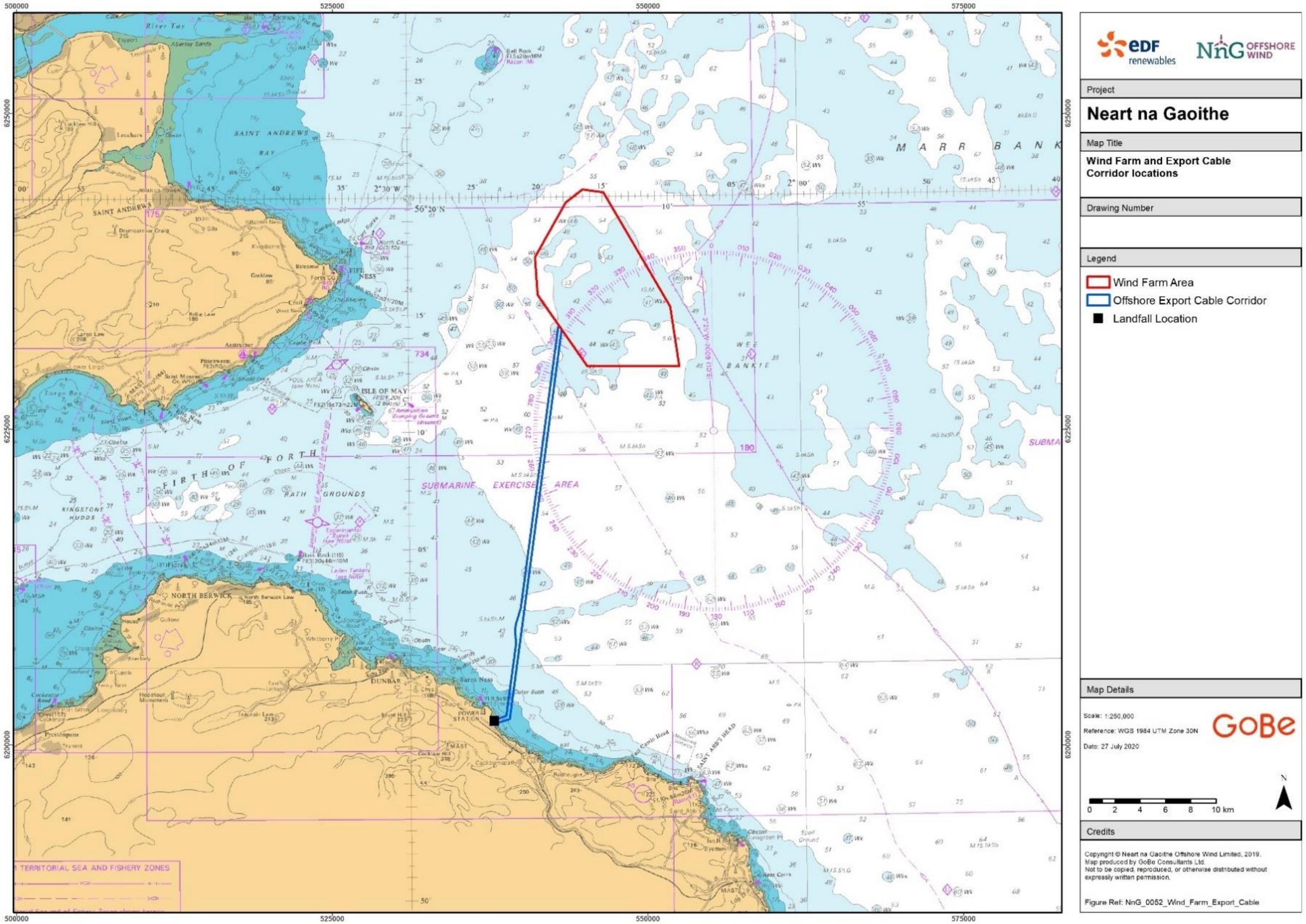


Figure 3-1: Wind Farm Area and Offshore Export Cable Corridor locations

4 Location and Layout of Cables

4.1 Introduction

17. This section describes the layout and location of the export cables, and the information that has been used to inform routing. This section includes surveys of the inter-array and interconnector cables for completeness.

4.2 Site Investigations

18. A series of geotechnical, geophysical and benthic surveys have been commissioned by NnGOWL to understand seabed conditions across the Wind Farm Area. The results of these surveys have been considered in defining the inter-array, interconnector and export cable routing (primarily driven by the array layout and landfall location) and installation methods. A summary of the pre-construction surveys conducted is provided in Table 4-1.

Table 4-1: Surveys relevant to this CaP

DATA SOURCE	COVERAGE	DATA USE	DATE
Geophysical surveys	Within and around the Wind Farm Area and Offshore Export Cable Corridor	Side Scan Sonar (SSS), Acoustic Ground Discrimination System (AGDS) and swath bathymetry used to inform site development (e.g. identification of a likely layout) and Environmental Impact Assessment (EIA).	2009
Geotechnical surveys	Within and around the Wind Farm Area	Cone Penetration Tests (CPTs), vibrocores and borehole sampling. Data used to inform site development and EIA.	2010
Sub-tidal benthic survey	Within and around the Offshore Wind Farm Area and Export Cable Route Corridor	Sub tidal sampling comprising of 0.1 m^2 Hamon grab for quantitative faunal and sediment analysis, seabed digital images collected using drop down video, 2 m epibenthic beam trawls and 0.04 m^2 Shipek grab for contaminant analysis. Data used to inform EIA.	2009
Intertidal biotope mapping survey	500 m cable corridor at the landfall location at Thorntonloch	Intertidal Global Positioning System (GPS) biotope mapping survey, core sampling and dig over survey to identify habitat distribution. Data used to inform EIA.	2009
Habitat mapping	Within and around the Offshore Wind Farm Area, Export Cable Route Corridor and landfall location	Interpretation of sub-tidal and intertidal benthic datasets for biotope classification and mapping. Data used to inform EIA.	2009
Preliminary assessment of coarse sediment benthic habitats	Within and around the Offshore Wind Farm area	Data interpretation to determine potential presence of geogenic stony reef used to inform EIA.	2011
Geotechnical surveys	Offshore Wind Farm Area and Offshore Export Cable Corridor	CPTs within the Wind Farm Area and CPTs and vibrocores along the Offshore Export Cable corridor. Data used to inform site development (e.g. refinement of layout).	2012
Geotechnical Survey	Offshore Wind Farm Area	Boreholes to inform site development and cable installation and protection methods and design.	2014

DATA SOURCE	COVERAGE	DATA USE	DATE
Geophysical Survey	Offshore Wind Farm Area focusing on lines orientated along rows of turbines following a north west to south east orientation	Multibeam echosounder (MBES) and SSS. Data used to inform site development (e.g. refinement of layout), pile installation and design.	2015
Geotechnical Survey	Offshore Wind Farm Area	Boreholes and CPTs. Data used to inform site development (e.g. refinement of layout), pile installation and design.	2018/19
Geophysical Survey	Offshore Wind Farm Area focused on intended works / infrastructure locations, and the Offshore Export Cable Corridor	MBES, SSS, magnetometer and sparker. Data used to inform pile design and installation and identify seabed preparation requirements. Data also analysed to refine Archaeological Exclusion Zones (AEZs).	2019/20
Nearshore Geophysical and Geotechnical Survey	Offshore Export Cable Corridor within the nearshore area from the landfall location to approximately 2 km offshore	MBES, SSS and sub-bottom profilers. Borehole sampling has been completed along a centreline within the Offshore Export Cable Corridor. Data used to inform nearshore and landfall Offshore Export Cable installation methodology. Data also analysed to refine AEZs. Data analysis and reporting concluded in March 2020.	2019/20
Geotechnical Survey	Offshore Wind Farm Area	Boreholes. Data used to inform detailed pile design and installation (e.g. pile drivability assessment). Data analysis and reporting concluded in March 2020.	2020

19. Following a review of all available survey data, a number of constraints were identified that required changes to cable routing and installation. These changes have been taken into account in developing the final cable routing presented within this this CaP.

4.3 Survey Outputs

4.3.1 Geophysical and Geotechnical Surveys

20. Bathymetry across the Wind Farm Area ranges from approximately 43 m to 58 m below Lowest Astronomical Tide (LAT). The shallowest water is located in the southern half of the Area, along a linear ridge orientated northwest to southeast, which rises 2 m above seabed level to 40.5 m. The deepest water, at approximately 58 m, occurs in the west of the Wind Farm Area close to the boundary within a channel orientated northwest-southeast.

21. Initial studies conducted to inform the Original Application for the Project (NnGOWL, 2012) and more recent survey work conducted in 2019 (Fugro, 2019) (See Table 4-1) both report that sediments within the Wind Farm Area mainly comprise muddy sand, fine to very fine sand and gravelly sand. These are underlain by varying depths of clay associated with the Wee Bankie formation and sediments associated with Forth and St Abbs formation. At the thickest point underlying sediment reach up to 73 m thick in two paleochannels that cross the Wind Farm Area. The bedrock beneath this consists of Carboniferous limestones in the east and sandstones in the west.

22. Water depths in the Offshore Export Cable Corridor reach 58 m LAT adjacent to the Wind Farm Area boundary (NnGOWL, 2012). Depths in the nearshore section of the Corridor out to approximately 2 km from the shoreline are highly variable due to the presence of exposed folded

bedrock that comprises the seabed here. Further offshore, out to approximately 7 km, the seabed gradient decreases and is generally flat and featureless, especially where soft sediment makes up the seabed surface. Along the Offshore Export Cable Corridor recent survey work generally corroborates the findings of earlier surveys (Fugro, 2019; 2020). Within the nearshore area the Offshore Export Cable Corridor comprises of bedrock with veneers of sands and gravels, and areas of deeper mixed sediments generally dominated by sand and gravel components (Fugro, 2020). Further offshore the Export Cable Corridor varies between areas of muddy sand with high clay and silt components and areas of coarser sand with gravel (Fugro, 2019). This is interrupted by a series of igneous dykes around 9 km offshore from the landfall.

23. The results of all surveys undertaken to date have been issued to the cable installation Contractor, who has used the data to undertake route engineering and identify the most appropriate cable burial tools and techniques.

4.3.2 Benthic Surveys

24. The dominant sediment type identified within the Wind Farm Area is slightly gravelly muddy sand, although patches of coarser sediment (e.g., sandy gravel and gravelly sand) were also recorded within the Wind Farm Area. Offshore characterisation surveys identified the presence of the biotope complex SS.SMu.CSaMu (circalittoral sandy mud) with epifaunal species present including seapens (e.g., *Virgularia mirabilis*) and brittlestars (e.g., *Amphiura* spp.). Infaunal species include polychaetes (e.g., Spiophanes bombyx) and bivalves (e.g., *Mysella bidentata*, *Abra* spp. and *Nuculoma* spp.) across the Wind Farm Area (NnGOWL, 2018).

25. Video analysis indicated biotopes more typical of soft sediments with polychaete tubes, megafauna burrows, seapens (e.g., *Pennatula phosphoracea* and *V. mirabilis*) and Chaetopterus tubes. These features suggest the presence of the Priority Marine Feature 'burrowed mud' and the component biotope SS.SMu.CFiMu.SpnMeg (Seapens and burrowing megafauna in circalittoral fine mud), covering a proportion of the Wind Farm Area.

26. A series of rocky substrates corresponding to the exposure of the Wee Bankie Formation were also observed during video analysis with areas of a highly variable seabed comprising a mix of substrate habitat types. These included large boulders and cobbles supporting a mosaic of the biotopes CR.MCR.EcCr.FaAlCr.Pom (faunal and algal crusts with *Pomatoceros triqueter* and sparse *Alcyonium digitatum* on exposed to moderately wave-exposed circalittoral rock) and CR.MCR.EcCr.FaAlCr.Adig (*A. digitatum*, *P. triqueter*, algal and bryozoan crusts on wave-exposed circalittoral rock).

27. The Offshore Export Cable Corridor is characterised by deep circalittoral mud and gravelly muddy sand, typical of the outer Firth of Forth. Further inshore, the cable route is characterised by deep circalittoral coarse sediment and low energy rock habitats.

28. The habitat complexes along the Offshore Export Cable Corridor closer to the Wind Farm Area comprised muddy sand biotope complexes. Further inshore, the area is characterised by coarse sediment (e.g. SS.SCS.CCS) comprising cobbles, pebbles, gravel and coarse sand. Conspicuous fauna identified from the video images comprised keel worms *Pomatoceros* spp. and crustaceans such as *Munida rugosa*.

29. Discrete areas of both the Wind Farm Area and the Offshore Export Cable Corridor supported dense areas of the brittlestar *Ophiothrix fragilis* which fitted the biotope SS.SMx.CMx.OphMx.

30. Benthic surveys have not identified any habitats that have influenced cable routing or installation methods. Furthermore, the Project does not overlap with any conservation sites designated for benthic habitat or species.

4.4 Key Constraints

4.4.1 Offshore Export Cable Corridor

31. The constraints detailed within the DSLP were considered in routing the export cable from the edge of the Wind Farm Area boundary to the OSPs. Along the Offshore Export Cable Corridor, the following physical constraints were identified:

- An AEZ; and
- Challenging ground conditions in the nearshore area (from landfall to approximately 1.25 km offshore), steep protruding bedrock at Kilometre Point (KP) 9 offshore from landfall and extended areas of uneven bedrock from landfall out to approximately KP 3.

32. Following appraisal of the geophysical data, this protruding rock feature at KP 9 was considered a hazard to the export cable installation process, causing an obstruction in two discrete areas. The geophysical survey identified an area of sedimentary substrates immediately to the west of the Offshore Export Cable Corridor. As a result, the Offshore Export Cable Corridor was extended to the west around these rock protrusions through this area with ground conditions known to be more conducive to cable burial as covered by the varied OfTW Marine Licence.

4.5 Location and Layout

4.5.1 Export Cables

33. The Wind Farm and OSPs are connected to the onshore transmission works (OnTW) by two High Voltage Alternating Current (HVAC) cables. The two offshore export cables are located within the Offshore Export Cable Corridor shown in Figure 4-1. The corridor is 300 m wide and approximately 33 km long from the landfall location to the Wind Farm Area boundary.

34. The export cables run from the OSPs and converge approximately 2 km inside of the boundary of the Wind Farm Area and then run broadly in parallel to the landfall location. Within the Offshore Export Cable Corridor, the cables were routed to avoid engineering and environmental constraints. The cables converge in the nearshore area at the landfall location. The cables make landfall on Thorntonloch beach on the East Lothian coast.

4.5.1.1 Route refinement

35. The location of the offshore export cables presented in Figure 4-1 includes the amendments to the route following analysis of the data collected as part of the completed survey campaigns detailed in Table 4-1 above. Refinements to the location of the offshore export cables were required in order to avoid an area of protruding rock at the seabed, which was considered to be a hazard to the export cable installation process at KP 9. The cable has therefore been re-routed around the rock protrusions through the Offshore Export Cable Corridor Extension Area identified by the geophysical surveys to have ground conditions known to be more conducive to cable burial.

Table 4-2: Export cable arrangement and lengths

ARRAY LAYOUT		START POINT			END POINT		APPROXIMATE LENGTH (KM)
START	END	LATITUDE (DDM) WGS84	LONGITUDE (DDM) WGS84	WATER DEPTH (M) LAT	LATITUDE (DDM) WGS84	LONGITUDE (DDM) WGS84	
NNG-OSS-N	Landfall	56° 16.446' N	2° 15.193' W	52.0	55° 57.599' N	2° 23.813' W	37.9
NNG-OSS-S	Landfall	56° 14.615' N	2° 14.395' W	48.0	55° 57.594' N	2° 23.809' W	37.6

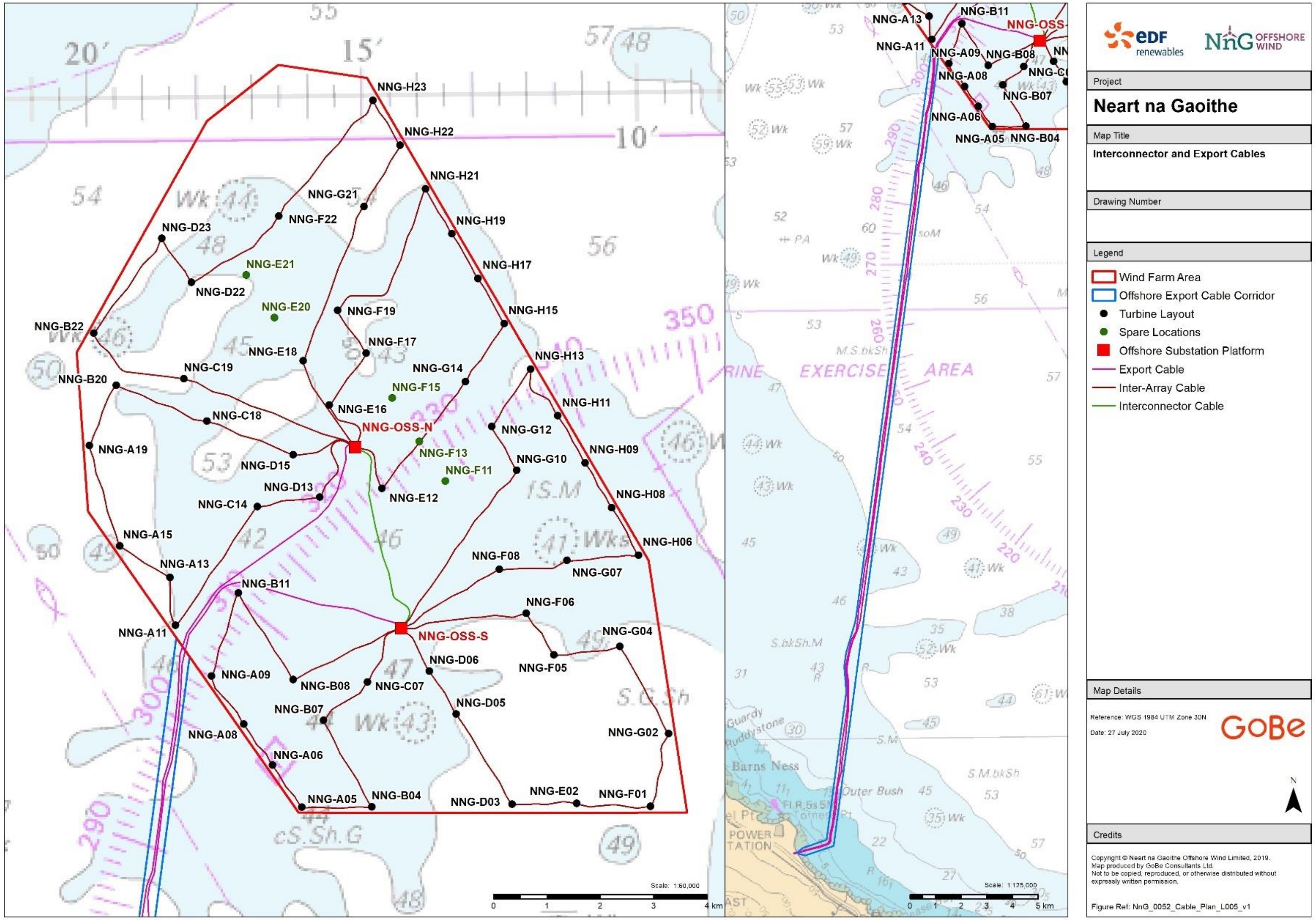


Figure 4-1: OSP locations and the interconnector and export cable arrangements to avoid known constraints within the Offshore Export Cable Corridor

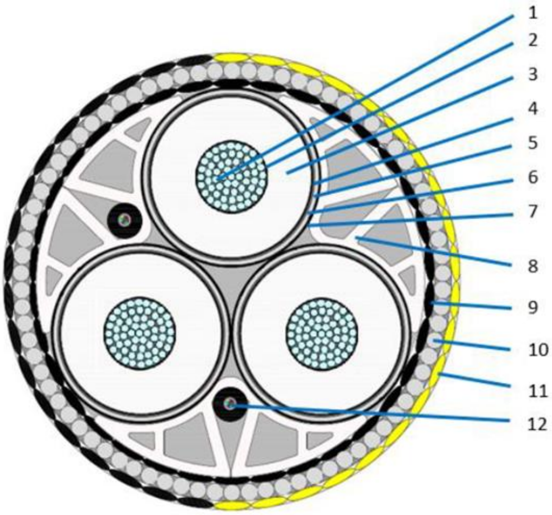
5 Technical Specification of Cables

5.1 Offshore Export Cables

36. The offshore export cables comprise two 3 core 220 kV armoured submarine power cables. The offshore export cables are designed in accordance with industry standards as set out in the relevant IEC and DNV-GL guidance.

5.1.1 Cable Components

37. The main components of the offshore export cables are shown in Figure 5- and are described briefly below.



Item	Description	Details
1	Conductor	Aluminium stranded power core covered with water blocked tape
2	Conductor Screen	Extruded semi-conducting compound
3	Insulation	Cross-linked polyethylene (XLPE)
4	Insulation Screen	Extruded semi-conducting compound
5	Water Barrier	Water blocking tapes
6	Metallic Sheath	Lead alloy sheath
7	Core Outer Sheath	Semi-conducting extruded polyethylene
8	Layup	Power core interstices filled with extruded shaped fillers
9	Bedding	Synthetic tape
10	Armour	90 galvanised steel wires flushed with bitumen
11	Serving	Polypropylene strings
12	Cables	48 single fibres supported in a water repellent gel within a stainless steel tube

Figure 5-1: Offshore Export Cable design

5.1.1.1 Power Cores

38. Each offshore export cables for the Project, comprise three power cores each with a cross-sectional area of approximately 630 mm^2. The conductors are formed mainly of aluminium conductors as shown in Figure 5-. Copper conductors were used within the horizontal ducts at the landfall location and within the OSP J-tubes, approximately 1km at each end of the export cables.

39. The cores are insulated with XLPE. For waterproofing each core is surrounded with a semi conducting water blocking tape suitable for subsea use.

5.1.1.2 Fibre Optic Data Cable

40. The offshore export cables are bundled with two fibre optic sub-cables supported in a water repellent gel within a stainless steel tube, protected by inner polyethylene sheath, galvanised steel wire armour and an outer polyethylene sheath.

5.1.1.3 Cable Armouring and outer sheathing

41. Appropriate filler materials (e.g. ropes or extruded polymeric profiles) are included within the cable interstices to provide a robust and stable base for the application of armouring.

42. The offshore export cables are then protected by one layer of galvanised steel wire flushed with bitumen for corrosion protection. The armouring provides external mechanical protection, weight and strength. Polypropylene rovings are applied over the armour wires for outer protection of the cable. The outer serving is black with a helical stripe for identification.

5.1.2 Electromagnetic Fields

43. This section summarises the results of a desk-based assessment carried out by the cable manufacturer on behalf of NnGOWL on the attenuation of EMFs associated with the offshore export cables.

44. The study calculated the magnetic field magnitudes at seabed level and 1 m above seabed level generated from the offshore export cables at a burial depth of 1.0 m. The magnitudes were calculated using the Finite Element Method. The study confirmed that EMF decreases rapidly with distance from the cables.

45. The modelling outputs predict that the EMF generated by the export cables will reduce to zero within 5 m of the cables when it is carrying the maximum current of 599 A. The maximum generated EMF identified is 0.014 mT at the surface of the seabed directly above the cable. Therefore, the predicted maximum magnetic field strength of the export cables at the seabed is expected to be lower than the earth's magnetic field (~0.05 mT).

6 Cable Burial

6.1 Introduction

46. Section 6.2 below provides a summary of the CBRAs undertaken to identify potential threats to the cables and proposes burial depths to minimize risk from these threats to protect the integrity of the installed subsea cables. Section 6.3 then sets out proposed cable burial and protection, which has been informed by the CBRA findings.

6.2 Cable Burial Risk Assessment

47. CBRA is a risk-based assessment undertaken to help determine an optimized Depth of Lowering (DoL) for subsea cables, such that threats to the cable and to other marine users (e.g. interactions between anchors or fishing gear with cables) can be avoided.

48. For the purpose of this CaP, cable burial depth will be described as the DoL. The DoL is the depth measured from the top of the cable to the surrounding mean seabed level (Figure 6-1).

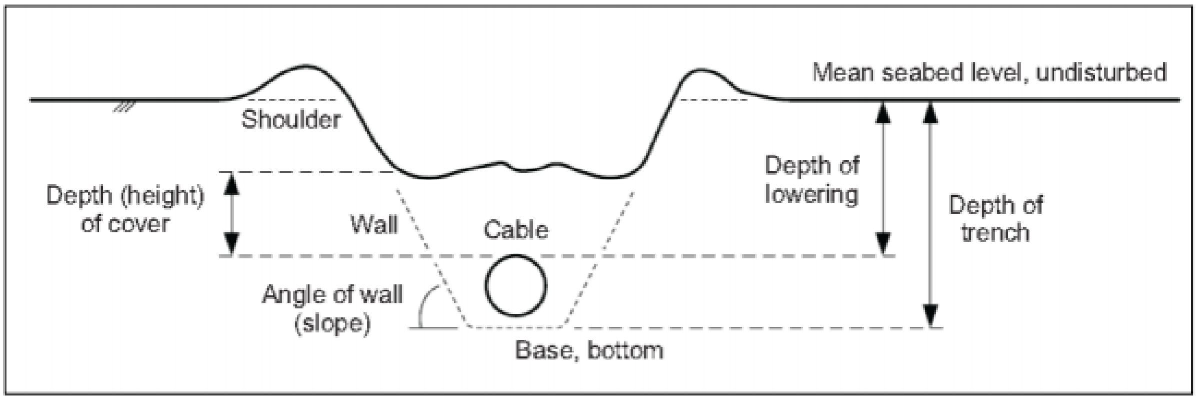


Figure 6-1: Cable DoL relative to Mean Seabed Level (MSBL)

49. CBRAs have been undertaken by external technical consultants Cathie in accordance with the following industry guidance documents:

- Carbon Trust (2015) Cable Burial Risk Assessment Methodology, Guidance for the Preparation of Cable Burial Depth of Lowering Specification, CTC835, February 2015;
- Carbon Trust (2015) Application Guide for the Specification of the Depth of Lowering using the Cable Burial Risk Assessment (CBRA) methodology, Dec 2015; and,
- DNV-GL (2016) Subsea Power Cables in Shallow Water, DNV-GL-RP-0360, 2016.

50. The CBRA method reviews threats based on their anticipated frequency (e.g. how often anchor strike can be expected to occur in the area) and consequence (e.g. to what depth anchors may penetrate the seabed). Once the frequency and consequence of the identified threats is understood, the CBRA investigates how the risk associated with that threat can be mitigated to an acceptable level (as determined by DNV-GL standards) by cable burial, based on known ground conditions (as informed by site survey data; see Sections 4.3.1 and 6.2.1) and prevailing hydrodynamic conditions (i.e. sediment mobility).

51. The CBRAs considered the following main threats:

- Anchor strike: Vessel data was analysed to understand vessel activity in the Project area based on site-specific AIS and radar data and coastal AIS data, and the anchor types and sizes associated with this activity were identified, allowing an understanding of likely depths of anchor penetration.
- Fishing gear interactions: Fisheries data was analysed to understand fishing activity in the Project area, the types of gear in use and the likely depths of gear penetration based on the most recent data collated by the Marine Management Organization (MMO) and the International Council for the Exploration of the Sea (ICES). See Section 6.2.3 for more detail.

52. Sediment mobility (considered a secondary threat): Existing seabed data were analysed to understand the potential for mobile bedforms and their thickness. The results of assessment remain indicative pending the analysis of recently gathered additional seabed survey data. The potential for mobile bedforms of 0.2 – 0.3 m thickness in some locations was identified.

6.2.1 Ground Conditions

53. Geotechnical and geophysical site investigations have identified several 'soil' types present across the Wind Farm Area, as summarized in Section 4.3.1. These include sand (with varying silt and gravel content), clay (of various strengths) and rock (dolomite, sandstone and siltstone, close to/at the seabed surface in places). Sands are widespread across the Wind Farm Area; low strength to medium strength clays are also relatively widespread; medium to high strength clays are found on seabed mounds; and rock is encountered at/near the seabed surface in some locations.

54. Soil conditions encountered along the Offshore Export Cable Corridor comprise loose to medium dense mud / sand overlying glaciomarine clays and bedrock. The sand cover is generally limited in thickness (< 1 m thick) and almost absent in some areas nearshore, where the underlying bedrock is sub/outcropping. Older muddy / clayey layers are dominant in the central stretch of the Corridor, where the bedrock deepens before re-emerging in close proximity to the Wind Farm boundary. Soils in the intertidal zone comprise sand with gravel and cobbles (indicated as 'firm sand') over stiff to very stiff, locally firm, silt and bedrock. The beach is widely covered by shingle, boulders and rocks.

6.2.2 Anchor Strike

55. A risk assessment of anchor strike was undertaken using Project-specific marine traffic survey data gathered during both winter and summer months across several years. Data included marine traffic information gathered using Automatic Information System (AIS) and radar during offshore survey work and shore-based AIS information on marine traffic. The maximum anchor penetration depth based on the vessel types present within the Wind Farm Area and the seabed conditions was considered to be 2.44 m; along the Offshore Export Cable Corridor the maximum penetration depth was estimated to be up to 6.64 m where there are thicker layers of soft clay. This is considered to be a conservative worst-case scenario as much of the Offshore Export Cable Corridor is comprised of stiffer sands and gravels and areas of rock.

56. Assuming unburied (surface-laid) cables, the risk return period from emergency anchoring to one export cable is > 26,000 years, with the cumulative risk of anchoring to both Offshore Export Cables being 1 in 9,326 years.

57. The corresponding values for the export cables were > 26,000 years for one cable and 1 in 9,326 years for both Offshore Export Cables.

6.2.3 Fishing Gear Interaction

58. A risk assessment of fishing gear interaction was undertaken based on MMO fisheries data and other data sets and the outcomes of consultation as detailed within the Application (NnGOWL, 2018).

59. These data sets include a detailed profile of the vessels operating from key fishing ports for vessels operating within the local and regional study areas, including number of vessels, length and age profiles, as well as descriptions of the fishing methods deployed. In addition, consultation with Scottish and Anglo-Scottish inshore and offshore fisheries stakeholders was undertaken to both ground-truth data and to understand temporal and spatial patterns of fishing activity (NnGOWL, 2018). Furthermore, these data sets were updated specifically for the CBRA, to ensure a recent overview of the baseline.

60. The probability of fishing gear and cables interacting is dependent upon gear type and dimensions; for the purposes of the precautionary assessment, trawling using otter boards was assumed as this is considered the worst case.

61. To mitigate the risk of interactions with fishing gear and based on a probabilistic assessment considering the type and frequency of fishing activity a recommended DoL of 0.2 m was determined in areas of sand, with 0.3 m DoL determined in areas of soft clay.

6.2.4 Sediment Mobility

62. The CBRAs undertaken for both the export cable and inter-array and interconnector cables also consider secondary hazards that may result in cable fatigue or abrasion. For example, surface laid cables would be subject to loading from waves and currents and this could result in cable migration across the seabed. Excessive movement on the seabed could cause abrasion and/or fatigue issues. Buried cables may be subject to exposure where there is a high degree of seabed mobility.

63. An assessment of bathymetry data and physical processes in the Wind Farm Area have not identified large mobile bedforms. Analysis of seabed conditions and local hydrodynamics indicate a maximum thickness of potentially mobile bedforms within the Wind Farm Area of up to 0.2 to 0.3 m. Within the Wind Farm Area effects of local tides and currents and sediment processes are not anticipated to be significant due to the depth and relatively low current speeds recorded.

64. Data along the Offshore Export Cable Corridor is limited however, sediment thickness along the cable route has been considered and no thick layers of mobile sediment have been identified. Sediment mobility along the Offshore Export Cable Corridor will be reviewed on receipt of the results of the ongoing geophysical surveys to identify any significant mobile bedform features.

65. Along the Export Cable Corridor, coastal processes may result in exposure of near shore cables, which could increase risk to cables from external threats and within the intertidal zones, dedicated cable installation and protection methods have been developed for cable protection at the landfall location comprising a mixture of Horizontal Directional Drilling (HDD), burial and mechanical protection as detailed in Section 7.1.2.1.

66. The NNG-ZET-SIV-REP-0001 Hydro Sedimentary Study conducted by Zetica in 2019 concludes that the NNG site is in a low energy depositional environment that has low sedimentation, erosion rate and negligible sediment transport. Its states that calculated accretion is likely artefact from the survey data acquisition and processing. Noting this NNG contracted Cathies to review high density multibeam echo sounder surveys from the construction phase to perform a bathymetric comparison exercise to refine the seabed mobility allowance. Most of the changes observed were depositional, commonly minimal

change of less than 0.1m, greater changes are very possibly the result of trenching operations and natural backfill where boulder fields were removed.

6.2.5 CBRA Findings

67. Table 6-1 below summarises the findings of the CBRAs.

Table 6-1: CBRA findings summary

THREAT	DOL AT WHICH RISK IS DEEMED ACCEPTABLE IN LINE WITH DNV-GL STANDARDS
Export cables	
Commercial shipping	1.0 m offshore 0.5 m nearshore (landfall to approximately 4 km offshore)
Commercial fisheries	0.2 m in areas of sand / harder ground 0.3 m in areas of soft clay
Final recommended DoL (taking account of above threats and seabed mobility)	1.0 m offshore 0.5 m nearshore (landfall to approximately 4 km offshore)

6.2.5.1 CBRA Summary

68. The CBRAs identify that the best means of mitigating against any potential threats to cables is cable burial, noting that routing cannot avoid the widespread nature of the threats considered.

69. The Application assumed a target burial depth of 1.0 m along the export cables. Table 6-1 above demonstrate that this DoL is sufficient to adequately mitigate the risk of cable strikes from anchors or fishing gear.

6.3 Cable Burial and Protection

70. The CBRAs identified the DoL at which threats to the cables are mitigated to an acceptable risk level. The results of the CBRAs have been used to inform intended cable burial and protection, as set out below.

71. It is anticipated that burial of cables to a target DoL of 1.0 m will be achieved along the majority of cable routes. In locations where DoL is either anticipated to be unfeasible during detailed design, or is not achieved during installation, there will be a potential requirement for localised additional protection along sections of cables. It should be noted that any requirement for additional cable protection will be within the consented limits, as follows;

- up to 15% of the total consented length of the export cable (12.8 km).

72. NnGOWL ensured that any consented cable protection works will not compromise safe navigation and, as such, did not exceed a maximum of 5% reduction in surrounding water depth.

73. On the basis of available information, rock protection was installed on some sections of the export cables, where burial to target DoL is not technically feasible. This is described below in Section 6.3.1.

6.3.1 Offshore Export Cables

74. Target DoL will vary along the export cable routes, as suggested in Table 6-1 above. The offshore export cables were buried beneath the seabed to a minimum target DoL of 1.0 m wherever possible along the majority of the route. Installation methods and tools were selected to maximise the likelihood achieving DoL.

75. At the landfall site, the export cables are routed through two pre-installed horizontal ducts beneath the seabed and under Thorntonloch beach. The CBRA indicated that out to approximately 4 km offshore from the landfall location, the risk of cable strikes is mitigated to an acceptable level with a DoL of 0.5 m, reflecting reduced vessel activity.

76. Where DoL was not achieved during installation, additional rock protection was installed to safeguard the cables from threats. The final achieved (i.e. as-built) burial profile for export cables was provided by the cable installation Contractor once cable installation and the post-lay survey was completed.

77. Survey data during the final route engineering for the offshore export cables, indicated the potential requirement for rock protection on some sections of the cables, where achieving target DoL is not technically feasible due to the presence of hard ground. Table 6-2 below summarises the anticipated target DoL and installation solutions along the export cable routes.

78. Available information indicated that KP 0 (landfall) to KP 4 (i.e. approximately 4 km offshore) is predominantly rock that could prevent target DoL being achieved; where this was the case there was a requirement for deployment of rock protection in discrete areas.

79. From KP 4 to the Wind Farm Area the seabed is comprised of predominantly sand or clay overlying bedrock, with soft ground of sufficient depth to allow for a jetting cable burial solution. Available information indicated that burial to anticipated DoL would be achieved along the majority of this route. One discrete area was identified where it may not be possible to reach the target DoL. The latest survey information indicated the presence of an outcrop of bedrock and highly variable bathymetry in the vicinity of KP 9 (i.e. approximately 9 km offshore). At this location, the presence of this outcropping rock was likely to inhibit safe installation of the export cable, and would require significant rock placement to mitigate the risk of cable freespan and sufficiently protect the cable. To mitigate the risk to cable installation and to remove the requirement for significant rock placement the cable was re-routed to the West of the rock outcrop through the Extension Area, as shown in Figure 6-2 below. This re-routed area enabled burial in adjacent soft ground and minimise any requirement for cable protection. The Extension Area was subject to an OfTW Marine Licence variation and is therefore now considered part of the consented Offshore Export Cable Corridor.

Table 6-2: Export cable protection options

LOCATION	APPROXIMATE KP LOCATIONS	TARGET DOL IN COMPLIANCE WITH THE CBRA	BURIAL TOOL OPTIONS THAT COMPLY WITH THE CBRA
Nearshore	KP 0 to KP 0.75	NA	Horizontal directional drilling
	KP 0.75 to KP 1.3	0.5 m	Mechanical cutting tool Barge mounted rock breaker
	KP 1.3 to KP 4.5	0.5 - 1.0 m	Mechanical cutting tool

LOCATION	APPROXIMATE KP LOCATIONS	TARGET DOL IN COMPLIANCE WITH THE CBRA	BURIAL TOOL OPTIONS THAT COMPLY WITH THE CBRA
Offshore	KP 4.5 to KP 38 (where hard ground)	1.0 m	Mechanical cutting tool
	KP 4.5 to KP 38 (where soft soils)	1.0 - 1.5 m	Jetting tool

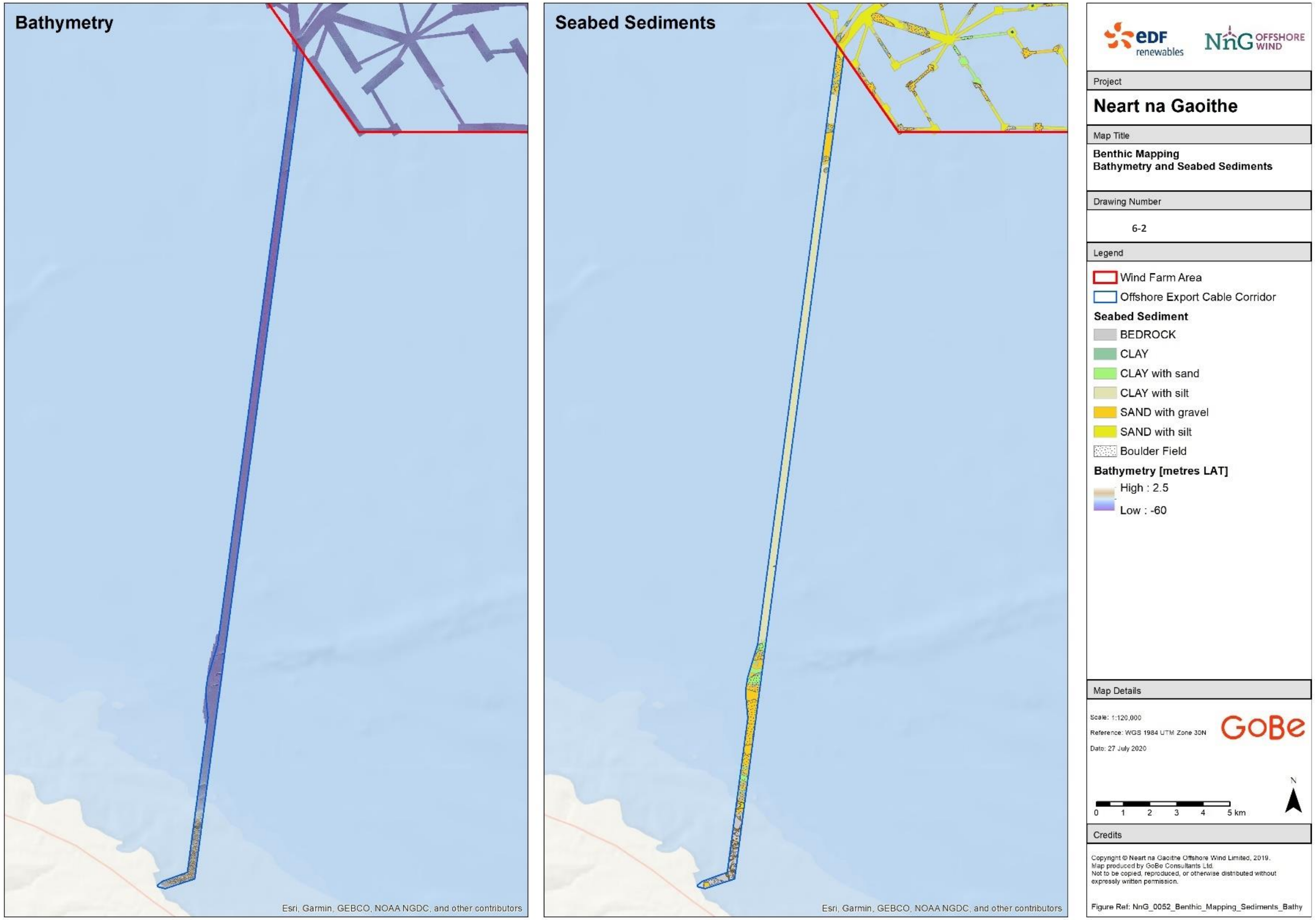


Figure 6-2: Offshore export cable corridor showing area of re-route at KP 9

7 Cable Installation Method

7.1 Offshore Export Cables

7.1.1 Installation Vessels

81. Table 7-1 details the main types of construction vessels and their role in the export cable installation campaign.

Table 7-1: Main export cable installation vessels

VESSEL TYPE	ROLE
Anchor Handling Tug (AHT)	Undertaking PLGR operations.
Dive Support Vessel (DSV)	May be required to assist with cable pull-in and preparation of exit pit at the landfall location.
Jack-Up Barge	To assist with cable burial in the near shore area, if required.
Backhoe Dredge Barge	To assist with cable burial / protection in the near shore area as required.
DP2 CLV*	Cable delivery from port of manufacture; Pre- and Post- lay surveys; Cable lying Cable trenching and burial
Offshore Support Vessel (OSV)*	Deployment of burial and trenching tools.

(*) Vessels present for full offshore wind installation campaign.

7.1.2 Method and Process of Installation

82. The export cable installation sequence is presented in Figure 7-1 below. Greater detail on each of the stages in the installation process (EC1 – EC4) is then provided in the subsequent sections.

- EC1 • Landfall works
- EC2 • Pre Lay Grapnel Run
- EC3 • Cable installation
- EC4 • Cable burial and/or installation of cable protection

Figure 7-1: Export Cable installation sequence

7.1.2.1 Export Cable Installation Stage EC1 – Landfall works

83. Ducts through which the export cables were pulled were installed underneath Thorntonloch beach using a HDD technique.

84. HDD involves drilling a bore underground between two points, into which ducting to carry electrical cable can be installed. To achieve this, an onshore drill rig commenced drilling at a HDD 'entry-pit' at the onshore end of the underground channel, above MHWS landward of the beach at Thorntonloch. The entry pit is approximately 70m from the Transition Joint Bay (TJB).

85. The 'exit pit' is located approximately 750 m seaward of the TJB and comprises an area of up to 20 m long, 20 m wide and 2 m deep for each export cable. A jack-up barge equipped with an excavator and/or a backhoe dredger or similar mechanical means undertaken by a team of divers was used to carry out the excavation works at this location. This material was side-cast until backfilling after duct installation.

86. The HDD drilling / cable installation process comprised the following stages:

- A small diameter pilot hole was drilled from the onshore entry pit to approximately 30 m form the exit pit, for the purpose of defining the path of the channel into which the ducts and later the cable was to be installed. The pilot rod was then removed and replaced by a reamer which is used to increase the diameter of the bore. The initial drill bore used bentonite drilling fluid which was retained within a closed system whereby drilling fluid, cuttings and spoil are in a recyclable loop. The final 30 m was not be drilled until after the rest of the bore was complete and the Bentonite, cuttings and spoil were recovered onshore; to minimise the potential for fines to be released to the marine environment during 'punch out'.
- The steel reamer was pushed through the pilot hole towards the exit pit, enlarging the diameter of the hole as it progresses. This may have been repeated a number of times, depending on the strength of the soil / rock through which it passes, in order to enlarge the bore diameter sufficiently as to accommodate the HDD ducts. The final 30 m was drilled using a biodegradable seaweed based or food grade gum called Flowzan or EcoBore. This approach minimised the release of bentonite into the marine environment

on 'punch out' and involved only a limited release of the biodegradable drilling fluid. As the drill is brought back towards the drill rig this also brought the majority of the drilling fluid and cuttings back to shore through the recycling system.

- The bore was punched out into the exit pit. This exit pit was excavated to a sufficient depth to receive the bore and High-density Polyethylene (HDPE) or steel duct pipe and to allow the export cable to be continuously buried beyond that point during installation. To reduce the likelihood of seabed material infilling the bore between punch out and duct installation, the bore may be temporarily capped by the positioning of sandbags or similar for a short duration until the HDD ducts have been pushed / pulled through.
- The duct pipe was installed into the bore by either pushing from the field onshore or pulling from offshore, using a winch through the bore. Once the duct iwas installed it was capped with a steel plate, or similar, and secured until ready for cable installation. The process was repeated for the second circuit. Once the duct installation was complete, the exit pit was backfilled with the excavated material and the seabed reinstated. The jack-up barge / backhoe dredger or similar equipment used for this task was then removed. A surface marker buoy will be temporarily deployed until cable pull-in operations commence.

87. Prior to export cable installation the jack-up barge and backhoe dredger, or similar mechanical equipment returned to the location of the surface marker buoy and excavate the exit pit following the same methodology as undertaken previously. The end of the HDD duct was exposed, and the temporary steel plate removed. A pre-installed rope was used to pull a winch wire through the HDD duct. When ready, the export cables were pulled from the CLV through the HDD duct pipe to the TJB, by means of the shore-based winch. When the cable was successfully pulled through the HDD ducts it was buried at the exit pit location using the material side-cast during excavation of the exit pit.
88. The CLV then sailed out towards the offshore wind farm area, continuing to lay the cable along the offshore export route.
89. Table 7-1 above details the main types of construction vessels required and their respective roles in the export cable to landfall installation campaign.

7.1.2.2 Export Cable Installation Stage EC2 – Pre-Lay Grapnel Run

90. Seabed debris or features (for example scrap trawler warps or ships' crane wires that may have been jettisoned by vessels onto the seabed) can be detrimental to the trenching or burial tool. Therefore, after boulder clearance and before the start of cable laying operations the cable route was cleared of any remaining obstructions by undertaking a PLGR.
91. An anchor handling tug will be mobilised with a towed grapnel rig. All intended cable routes will be subject to PLGR.
92. Any debris recovered to the deck will be retained on board the vessel for disposal onshore.

7.1.2.3 Export Cable Installation Stage EC3 – Cable installation

93. In the event that the cable installation Contractor proposes an installation procedure involving a burial tool that has not previously been proven in similar ground conditions, it would be necessary to carry out a trial to test the capability of the burial tool to achieve the required burial depth. The results of the trial will be used to confirm the adequacy of the tool or to inform minor adjustments to the tool, to be made whilst offshore, to ensure its adequacy. This approach will assist in

minimising the risk of ineffective cable burial and thus of the deployment of rock protection. A variation was approved by MD-LOT to amend the Offshore Consents in order to cover trenching trials if required. However, no trials were required.

94. The export cable was loaded onto the CLV turntable at the cable manufacturing facility. There was one load out per export cable.

95. Cable installation commenced at the landfall with cable pull in through the installed ducts. The shore end site area was prepared, including rigging safety barriers, excavating the onshore trench, exposure of the ends of the HDD, the installation and testing of the winch(s) and liaison with the offshore teams.

96. The ducts were exposed, having been left shallow buried, and the exit flange was removed. The HDD was flushed with a suitable amount of water to displace any debris that may be present and cleaned using a mandrill guided by ROV or a dive team.

97. On approaching the landing point, the CLV positioned itself as close to the exit of the cable ducts as possible but at a safe working water depth. This position was at approximately the 10 m depth contour.

98. The nearshore support team then passed the messenger wire to the CLV waiting offshore. The cable head was attached to the messenger wire which was hauled back through the pre-installed ducts as the CLV is paid out from the CLV (Figure 7-2).

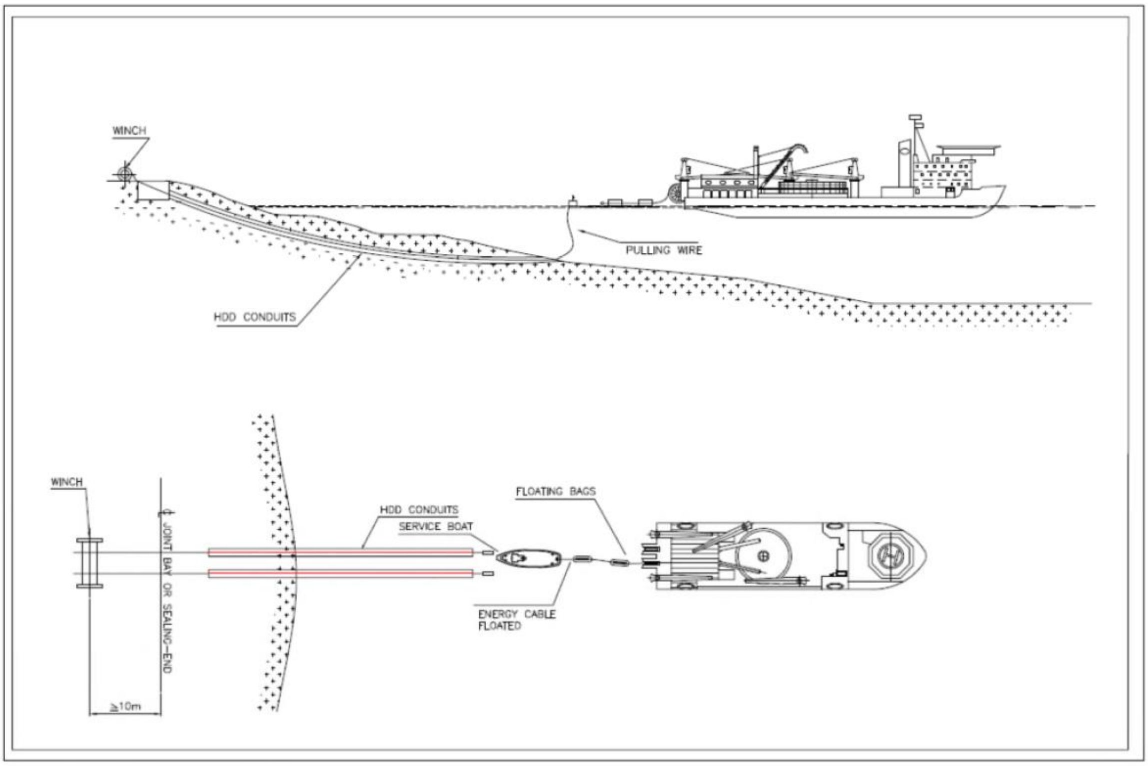


Figure 7-2: Illustration of landfall cable pull-in operations

99. A pull-in winch located onshore drew the cable through the ducts. The cable was paid out by the CLV. Floats were attached to the cable as it is paid out at intervals up to the position of duct. The cable pull in was monitored by ROV, or by a dive team.

100. Once the cable was pulled into the ducts and secured onshore, the support team ensured the cable was located over the proposed cable route and commenced removing floats between the duct and the cable vessel. The final position of the cable was recorded by ROV or divers.

101. Once all floats were removed the CLV progressed along the route laying the cable on the seabed.

102. The CLV continued to lay the cable and monitor the touch down location along the export cable route in the direction of the OSP. The OSP preparation team began on site checking and setting up the equipment for the installation of the export cable to the platform. The messenger wire was pre-installed in the J-tube at the fabrication yard and was suitable for recovery on site by a ROV. On site the wire was replaced with a pulling line of a suitable length and strength for the cable pull in operation.

103. Once at the OSP the CLV stopped approximately 100 m from the platform. The export cable was cut and sealed at the appropriate length and routed around a quadrant and through the CPS for second end pull-in operations. A ROV recovered a messenger wire that was pre-installed inside the J-tubes during OSP foundation fabrication.

104. The cable pull-in operations, managed from the OSP, followed these steps describing the first end cable pull-in:

105.

- The pull-in hoisting equipment were lifted onto and set up on the OSP foundation.
- The assembled CPS will be arranged on the deck of the CLV and the sealed end of the cable will be pulled from the carousel and through the CPS on the back deck of the CLV.
- The messenger wire is pre-installed in the foundation J Tubes prior to load out. It was recovered from the foundation J-tube to the CLV by means of an ROV. It was then connected to the front of the cable on the CLV.
- The cable was pulled off the CLV and into the J tube by the messenger wire. This was controlled by a team on the foundation controller a winch and a team monitoring the cable on the CLV. An ROV also monitored entry of the cable into the J Tube.
- The cable was secured in the foundation by means of a hang off clamp to ensure it did not slip back down the J Tube.

106. A typical cable 1st End Pull-in operation is illustrated Figure 7-3**Error! Reference source not found.** and described below.

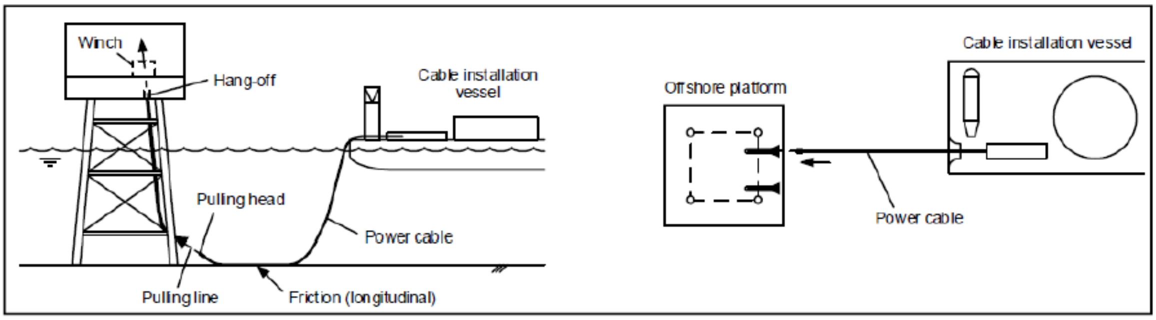


Figure 7-3 Typical 1st end pull-in operation

107. Following 1st end pull-in of the cable the CLV commenced laying along the planned cable route towards the OSP pull-in location.

108. Personnel undertook preparatory work on the OSP foundation prior to arrival of the CLV as detailed prior to first end cable pull-in.

109. The CPS was prepared on the deck of the CLV during transit towards the OSP. The CLV stopped cable laying at a pre-determined distance from the second end pull in location and cut and seal the export cable. The cut and sealed end of the cable was then routed round a cable quadrant and through the CPS.

110. The messenger wire was again recovered onto the CLV and attached to the cable. The quadrant was then moved towards the stern of the CLV and lifted by the vessel winch located on an A-frame. The quadrant was then lowered to the seabed as the second end of the cable was pulled in through the J-tube of the OSP foundation and terminated in the same way as first end pull in operations.

111. A typical 2nd end pull-in operation is illustrated in Figure 7-4**Error! Reference source not found.**.

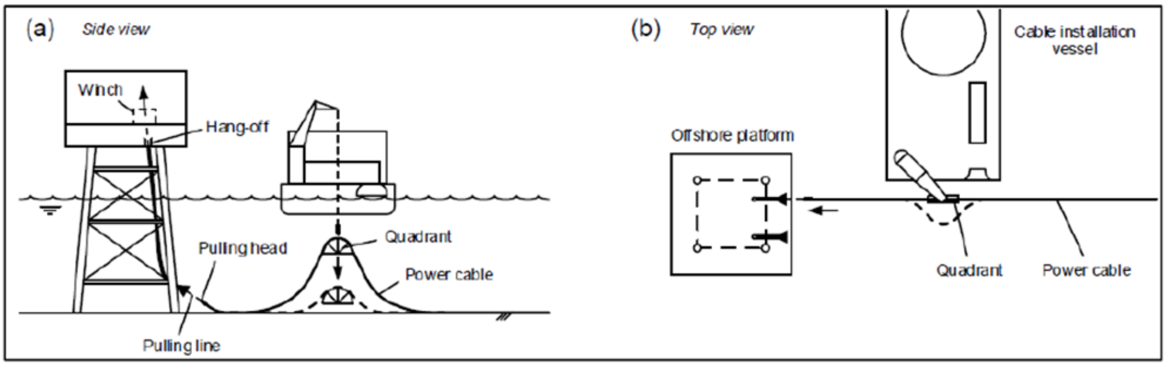


Figure 7-4: Typical 2nd end pull-in operations

112. When the quadrant reached the seabed, it was then tripped to offload the cable.

113. Following installation testing and termination of the cables was conducted by personnel transferred onto the jackets from the walk to work vessel or CTVs.

7.1.2.4 Export Cable Installation Stage EC4 – Cable burial and protection

114. The surface laid cable was then buried into the seabed to the target DoL. A jetting tool was used in softer ground conditions and a mechanical cutting tool over harder ground; slightly different tools were used to support the same process in the nearshore area between the 10 m depth contour and the cable duct exits. Burial was completed from an OSV equipped for trenching or burial, and in the nearshore area a backhoe dredge barge was used to assist.

115. Following cable burial, a post-lay survey of the cables was completed to determine the DoL. Where the target DoL is not achieved alternative protection methods were considered. The following materials were considered for cable protection:

- Durable crushed or original rock of defined size range;
- Concrete ‘mattresses’; and
- Bags (high strength nylon fibre) of gravel, hardened sand-cement grout, or concrete (grout / concrete pre-filled and hardened onshore). The bag option may include a technique where the grout is introduced to the nylon fibre bag offshore through proprietary pipes (the bags being permeable to water but not to grout).

116. NnGOWL may consider alternative cable protection systems. Where an alternative cable protection solution is used that is not covered by the licensed deposits on the OfTW Marine Licence these will be subject to approval of an additional marine licence or variation to the existing Offshore Consents.

117. Ongoing engagement with fisheries organisations will be, and will continue to be, undertaken in accordance with the Fisheries Liaison Strategy, outlined within Section 5 of the FMMS, in accordance with FLOWW (2014) Best Practice Guidance. NnGOWL confirm that where it is identified that rock placement was required, NnGOWL issued a NtM containing the justification of the requirement for cable protection in that location. A clear chart and coordinates illustrating the location of the cable protection would be included within the Notice.

118. Within the Application (NnGOWL, 2018), NnGOWL committed to undertake over trawls on export, inter-array and interconnector cables in locations where protection has been installed, in order to ensure that the protection scheme has been successful. Where it is confirmed that cable burial to DoL has been achieved by post-lay survey (see para 100), NnGOWL will not undertake over trawl investigations. Where target DoL is not achieved and additional cable protection is deployed, over trawl investigations were be undertaken by NnGOWL, through agreement with SFF. Following completion of the overtrawl survey, the SFF confirmed no issues were experienced during the operations and at the time of the trials the swept areas were found to be safe for normal fishing operations.

119. The methodology was agreed with MD- in consultation with the SFF, in accordance with the Fisheries Liaison Strategy outlined within Section 5 of the FMMS, taking account of:

- The extent and location of the cable protection material;
- The design of the cable protection material (noting that these can be designed to minimise effects on towed fishing gear); and
- The amount and type of fishing activity observed along the cable routes.

7.2 Seabed Deposits

120. Seabed deposits have been recorded and reported to MD-LOT on a Transportation Audit Report (TAR) submitted monthly throughout construction in accordance with Condition 3.2.3.1 of the OfTW Marine Licence. Within one month of completion of construction a final audit report was issued to MD-LOT detailing the full deposits deployed as required by Condition 3.2.4.2 of the OfTW Marine Licence.

121. Within one month of completion of Construction NnGOWL will provided the “as-built” positions of all structures and any sub-sea infrastructure associated with the Project to MD-LOT. This information was also forwarded to the UK Hydrographic Office (UKHO) and Defence Geographic Centre (DGC) for aviation and nautical charting purposes as required by Condition 3.2.4.4 of the OfTW Marine Licence.

8 Operation and Maintenance

8.1 Introduction

122. This section sets out the anticipated O&M activities associated with the offshore export cables. NnGOWL is required to sell and subsequently transfer ownership of the Transmission Assets (comprising the offshore export cables, and the OSPs[2]) to an Offshore Transmission Operator (OFTO). After the transfer of ownership, the OFTO will take on responsibility for the O&M measures associated with the Transmission Assets.

123. This section sets out indicative O&M procedures, which are fully described in the Operation and Maintenance Programme (OMP).

8.2 Ongoing cable inspections

124. During the operational phase of the Project, further cable or seabed surveys will be undertaken to confirm that cables remain buried.

125. A survey was undertaken approximately 1-year post-installation to confirm the cables remain buried. The frequency and scope of further monitoring will be proportionate to the risk of future cable exposure and determined based on comparisons with the initial post-installation survey results. The following surveys or inspections may be considered as part of ongoing O&M activities:

- Geophysical surveys along all routes or those routes which are considered at risk of exposure based on initial post-installation survey findings;
- Surveys at approaches to structure J-tubes where there may be greater risk of scour / erosion; and
- A Distributed Temperature Sensing (DTS) system or similar will be installed to remotely and continuously monitor cable health from the O&M base.

8.3 Cable exposure

126. In the event of cable exposure, cable sections will be inspected to determine the full extent of exposure. An assessment will be undertaken to determine the risk posed by the exposed cables to other sea users and to the OfTI. Where the risk is unacceptable, remedial action will be undertaken to ensure the cable is adequately protected. The following measures will be considered:

- Reasonable endeavours will be made to re-bury the cable to a safe DoL taking into account the risk of exposure re-occurring;
- Placement of rock bags or rock armour or suitable alternatives such as frond mats, tyre mats etc[3]., at the cable ends to mitigate cable movement / migration; or
- Placement of additional rock armouring along the length of exposed cable. This approach is considered a last resort and would be agreed in advance of deployment with MD-LOT.

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[2] Some elements of the OSPs will be retained as part of the Wind Farm Assets.
[3] Alternative cable protection solutions not covered by the licensed deposits on the Wind Farm or OfTW Marine Licence will be subject to approval of an additional marine licence or variation to the existing Offshore Consents.

8.4 Cable failure

127. The following sections outline procedures to repair or replace damaged or faulty subsea cables.

128. Repairs will be conducted by a CLV or suitable alternative vessel such as a jack-up vessel. Depending on the location of the fault the following cable repair options will be considered. The following lists set out indicative procedures associated with potential cable repair scenarios.

8.4.1 Replacement of a section of subsea cable

129. The following steps provide an indicative overview of the procedure to cut out a section of cable in the middle of a length and insert a new piece of cable using two cable joints:

i. The repair vessel will de-bury the damaged section. It is likely that the cable will be exposed using a jetting tool and/or mass flow excavation;

ii. The cable will be cut either side of the damaged location subsea using an ROV;

iii. The cable repair vessel will then recover the first end of the export cable to be repaired;

iv. A cable joint will be used to connect a repair section of cable to the cut end of the recovered cable;

v. The second end of the cable to be repaired will then be recovered. This end of the cable will be connected to the other side of the cable repair section using a second cable joint;

vi. The repaired cable will then be lowered to the seabed. The cable repair section will result in a bight (loop) at the repair location;

vii. The cable will then be re-buried using the most appropriate burial tool or protected using rock protection or following the same procedure detailed under Section 7.1.2.4**Error! Reference source not found.**.

8.4.2 Replacement of a section of cable adjacent to a turbine or OSP

130. The following steps provide an indicative overview of the procedure to replace a section of cable close to a structure:

i. The repair vessel will de-bury the damaged section. It is likely that the cable will be exposed using a jetting tool and/or mass flow excavation;

ii. Once the location of the damage is identified the cable end closest to a structure will be identified for recovery;

iii. The cable will be cut at the location of the damage either subsea using an ROV or recovered and cut on the deck of the CLV;

iv. The cable end identified for recovery will then be disconnected from the turbine or OSP and recovered to the CLV;

v. The CPS will be recovered to the cable repair vessel;

vi. The CLV will then return to the location of the cut cable and recover the second end of the cable;

vii. A cable joint will be used to connect a repair section of cable to the cut end of cable still connected to the turbine or OSP;

viii. The cable will then be returned to the seabed and cable lay will commence towards the disconnected turbine or OSP. Once at the turbine or OSP location second end-pull-in will be completed. It is anticipated that cable lay, and second pull-in will be completed using the same procedure detailed under Section 7.1.2.3;

ix. The cable will then be re-buried using the most appropriate burial tool following the same procedure detailed under Section 7.1.2.4**Error! Reference source not found.**.

8.4.3 Replacement of a section of cable at the Landfall

131. The following steps provide an indicative overview of the procedure to replace a section of cable close to the landfall TJB (Export Cable Only):

i. The repair vessel will de-bury the cable around the HDD exit point using a jetting tool, mass flow excavation, or using a backhoe dredge or grab if required;

ii. The cable will be disconnected at the onshore TJB and the repair vessel will recover the redundant cable from the horizontal duct at the landfall location;

iii. A new length of cable will then be installed through the horizontal ducts following the same procedures set out in Section 7.1.2.1;

iv. Cable installation will then commence until it reaches the cut end of the export cable, as described under Section 7.1.2.3;

v. The cut end of the export cable will then be recovered to the repair vessel and connected to the newly installed cable using a cable joint;

vi. The cable will then be re-buried using the most appropriate burial tool following the same procedure detailed under Section 7.1.2.4.

9 Compliance with the Application

9.1 Introduction

132. Sections 9.2 and 9.3 sets out information from the Application with regard to:

- Compliance with the cable installation details as assessed in the Application; and
- Cable installation-related mitigation measures detailed in the Application.

9.2 Compliance with Installation Details Assessed in the Application

133. The EIA Report described a range of specification and layout options that could be applied during the construction of the Project.

134. Since the Offshore Consents were awarded, the design of the Project and approach to installation has been refined to that described in this CaP (and in other relevant Consent Plans). In order to demonstrate compliance of this refined design, the installation methods and cable specifications described in the EIA Report are compared to the installation methods and specifications detailed within this CaP.

9.2.1 Offshore Export Cable Installation

135. Figure 9-1 summarises the Offshore Export Cable options and assumed installation methods presented within the Application. It also summarises the selected options and confirmed installation methods described in this CaP.

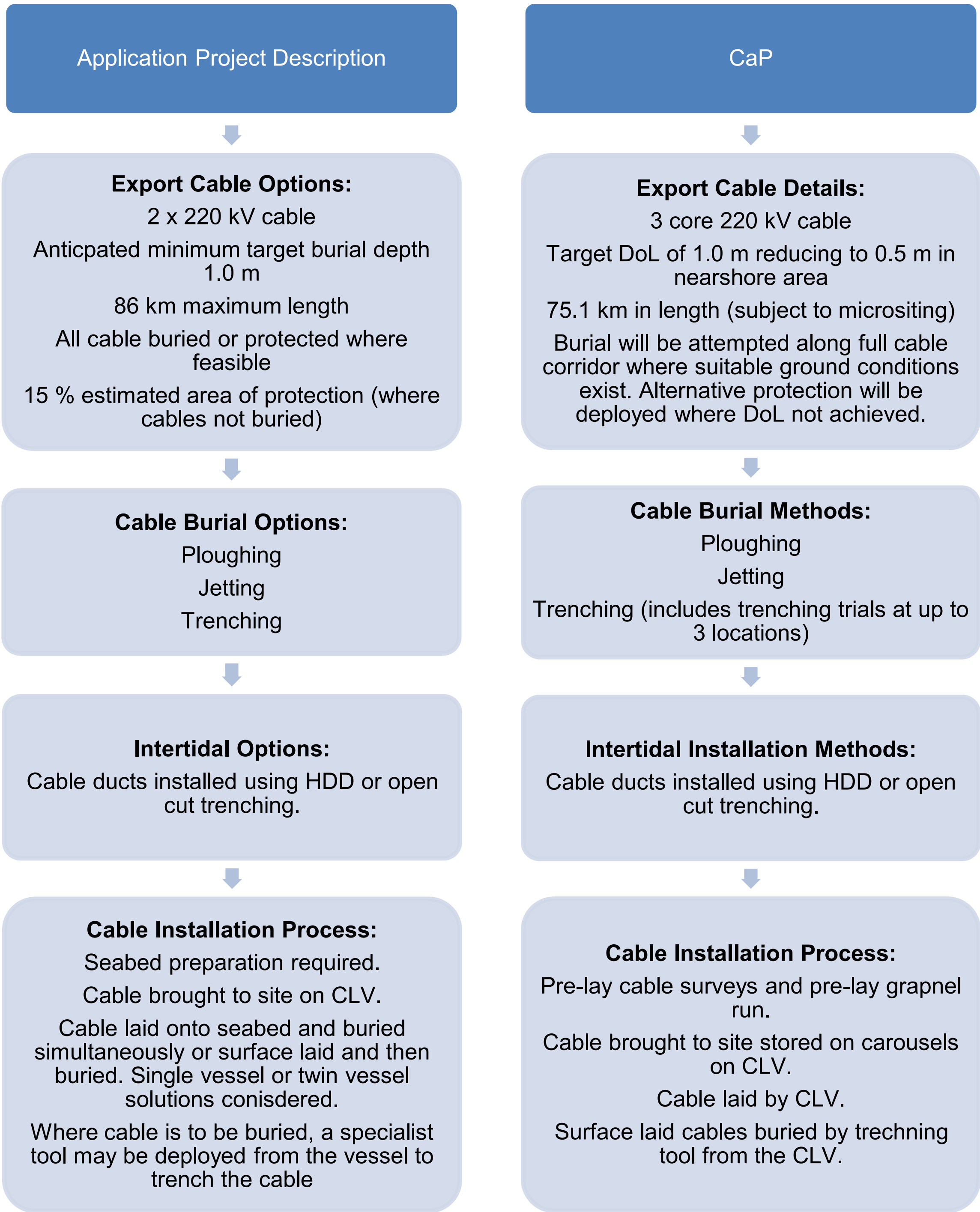

Figure 9-1: Comparison of Offshore Export Cable installation methods described in the Application and CaP

9.3 Delivery of Mitigation Proposed in the Application

136. The EIA Report detailed mitigation measures of relevance to the export cable installation activities. The relevant mitigation measures are detailed in Table 9-1, which identifies where each commitment has been addressed within this CaP or within other NnGOWL Consent Plans where appropriate.

Table 9-1: Construction related mitigation measures relevant to the CaP

CONSTRUCTION PROCESS	MITIGATION MEASURE	WHERE ADDRESSED
Cable Installation		
Cable protection	Cable will be buried where possible to mitigate impacts on physical processes, benthic habitats and other sea users. Cables, where techniques allow, should be back filled to increase recovery rates.	Described in Section 7. Where ground conditions permit jetting, sediment will settle back into the cable trench.
Cable Specifications	Cable specifications will be compliant with industry standards and best practice such as the relevant IEC specifications to minimise risk of effects resulting from EMF to benthic and fish communities.	See Section 5
Pre-construction cable route survey	Conduct a pre-construction cable route survey to identify any sensitive seabed habitats. Should such habitats be recorded, the Offshore Export Cable Corridor will be micro-sited, in consultation with Nature Scot (formerly SNH) and other stakeholders via submission, for approval, to MD-LOT of a CaP.	See Section 9.3.1

9.3.1 Pre-Construction Cable Route Surveys

137. Previous baseline habitat surveys conducted to inform the Original Environmental Statement (ES) did not identify any areas of habitat with a high conservation value, such as reef or shellfish beds, within the Offshore Export Cable Corridor. The ES prepared in support of the Originally Consented Project (NnGOWL, 2012) concluded that there would be no significant impacts on benthic communities. These conclusions were validated in the Scoping Report (NnGOWL, 2017) for the Project and subsequently scoped out of further assessment in the Application (NnGOWL, 2018).

138. Recent high-resolution geophysical surveys have been completed along the length of the offshore Export Cable Corridor (See Section 4.2 for details). The aim of the survey work was to confirm seabed conditions to inform cable routing and installation methods. The Offshore Export Cable Corridor is 300 m wide along the majority of its length, which constrains micro-siting options. Given the low risk to benthic communities, the limited spatial extent of any impact and the limited scope for micro-siting within the Offshore Export Cable Corridor, NnGOWL do not see the value in undertaking further benthic habitat surveys and do not plan to undertake further benthic habitat surveys along cable routes prior to cable installation.

10 References

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