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**CABLE PLAN**

**KINCARDINE OFFSHORE WINDFARM PROJECT**

Prepared	Checked	Reviewed	Approved
	23-03-2018	23-03-2018	23-03-2018
Organisation: KOWL	Organisation: KOWL	Organisation: KOWL	Organisation: KOWL
Name / signature: Malcolm Bowie	Name / signature: Amy Parry	Name / signature: John Giles	Name / signature: Alan West



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WINDFARM PROJECT**

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**Revision History**

Date	Rev. Status	Purpose of Issue*	Remarks	Initials
21-03-2018	A1	For Review		JD
23-03-2018	B1	External Review	Issued for External Review	JD

\*Purpose of Issue: for information, for review, for approval



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- **ACRONYMS, ABBREVIATIONS and DEFINITIONS**

AC	Alternating Current
ALARP	As Low As Reasonably Practical
CaP	Cable Plan
DDSFb	Dee District Salmon Fisheries Board
EMF	Electromagnetic Field
HDD	Horizontally Directional Drill
KOWL	Kincardine Offshore Wind Farm Limited
m	Metre
MCA	Maritime and Coastguard Agency
MS-LOT	Marine Scotland Licensing Operations Team
MW	Mega Watt
NLB	Northern Lighthouse Board
nm	Nautical Mile
OREI	Offshore Renewable Energy Installation
s	Second
UKHO	United Kingdom Hydrographic Centre
UXO	Unexploded Ordnance
WROV	“Work Class” Remotely Operated Vehicle
ES	Environmental Statement

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## 1. INTRODUCTION

### 1.1. Purpose of the Document

This document has been authored to satisfy Condition 17 of the Section 36 Consent issued to Kincardine Offshore Windfarm Ltd (KOWL) for the Kincardine Offshore Windfarm (the Project). This document provides the current Cable Plan (CaP) proposed for the Project, (see Section 1.5 for the wording of the condition).

### 1.2. Scope of the Document

This document outlines the location of the export and inter-array cables known at the time of writing based on the results of site investigation, and the cable laying, and monitoring techniques to be used during installation. The scope includes both the export cables and inter-array cables, however, it should be noted that only Export Cable 1 will be installed in Tranche 1 (see Section 1.3 for details on the Tranches), and this document will be updated prior to the commencement of further Tranches as necessary.

### 1.3. Project Overview


The Project is considered a commercial demonstrator site, which will utilise floating foundation technology, and is the second floating wind turbine farm array. It has been included within the Survey, Deploy and Monitoring scheme for offshore renewable systems (similar to wave and tidal devices).

The Project is located south-east of Aberdeen approximately 8nm (15km) from the Scottish coastline, in a location that provides suitable water depth for a floating offshore wind demonstrator development (approximately 60-80m) (Figure 1-1).

The project is split into the following areas:

- The Development Area – the wind farm area including the Wind Turbine Generators (WTG) and inter-array cables.
- The Offshore Export Cable Corridor – the area within which the proposed export cables will be laid, from the perimeter of the Development Area to the onshore area at Mean High Water Spring (MHWS).
- The Onshore Area – the onshore area above Mean High Water Spring (MHWS) including the underground cables connecting to the onshore substation at Redmoss.

This CaP focuses on the offshore elements only as per Section 36 Consent and Marine Licences granted.

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In April 2016 KOWL submitted applications for consent to construct and operate the Project, which included the Original ES. In September 2016 an addendum (referred to as the ES Addendum), of additional environmental information to the Original ES, was also submitted. In March 2017 consent under Section 36 and Section 36A of the Electricity Act 1989 was granted.

Since consent was granted, there have been several necessary changes to the Project. Therefore, an application for a variation of the Section 36 consent granted by the Scottish Ministers under S36C of the Electricity Act 1989 was applied for in December 2017 (the 'Variation Application').

The table below outlines the application dates, relevant ES Documents and the components of the Project as were included in the Original Application and the Variation Application.



*Table 1-1 Summary of document timelines*

Original Documents	Addendums	Variation
Date Submitted: March 2016	Date Submitted: September 2016	Date Submitted: November 2017
Original Application	Original Application	S36C Variation Application
Kincardine Offshore Windfarm ES (Original ES)	ES Additional Information Addendum (ES Addendum)	Section 36C Variation ES (Variation ES)
Maximum generation capacity: 50MW	Maximum generation capacity: 50MW	Maximum generation capacity: 50MW
WTGs: 8 x 6MW	WTGs: 8 x 6MW	WTGs: 1 x 2MW and 6 x 8.4MW
Substructures: semi-submersible	Substructures: semi-spar	Substructures: combination of semi-submersible and semi-spar
Cables: 33kv inter-array and export cables	Cables: 33kv inter-array and export cables	Cables: 33kv inter-array and export cables

### **Project Components**

As noted in the table above, the maximum generation capacity of the windfarm is capped at 50MW, the main difference between the various stages of the applications have been the number and size of the turbines, and the substructure type.

As applied for in the Varied Application, the Project will now consist of the following offshore components:

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- WTGs: 1 x 2MW and 6 x 8.4MW
- Substructures: semi-submersible Windfloat™ design
- 33kv inter-array and two export cables

Onshore, the following construction activities will also take place (under permissions granted by Aberdeen City Council):

- Onshore substation
- Horizontal Directional Drilling landfall and onshore cable route



### Construction Programme Overview

The construction of the Project is anticipated to occur in 'Tranches' in-line with the indicative Programme outlined below. A final Construction Programme for each tranche will be provided to Scottish Ministers prior to commencement of the construction as a requirement of the consent conditions.

*Table 1-2 Indicative construction programme*

Tranche	Activities	Indicative Start Dates
Tranche 1	Onshore works and HDD drilling	March 2018
	Mooring installation Turbine Location 1	May 2018
	Export Cable 1 installation	May 2018
	Installation of 2MW turbine to Location 1	June 2018
Tranche 2	Export Cable 2 installation	April 2019
	Mooring installation Turbine Locations 5-7	April 2019
	Installation of inter-array cables Locations 5-7	Aug 2019
	Installation of turbines to Locations 5-7	Aug 2019
Tranche 3	Mooring installation Turbine Locations 1-3	March 2020
	Installation of inter-array cables Locations 1-3 and 8	June 2020
	Move 2MW to Location 8 (dependent on recertification and consultation as noted above)	June 2020
	Installation of turbines to Locations 1-3	June 2020



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Please note, Export Cable 2 may be installed as part of Tranche 1; however, at the time of writing this CaP the timing was still to be decided. This will be confirmed in due course, and this document updated if required as per Section 1.4 below.

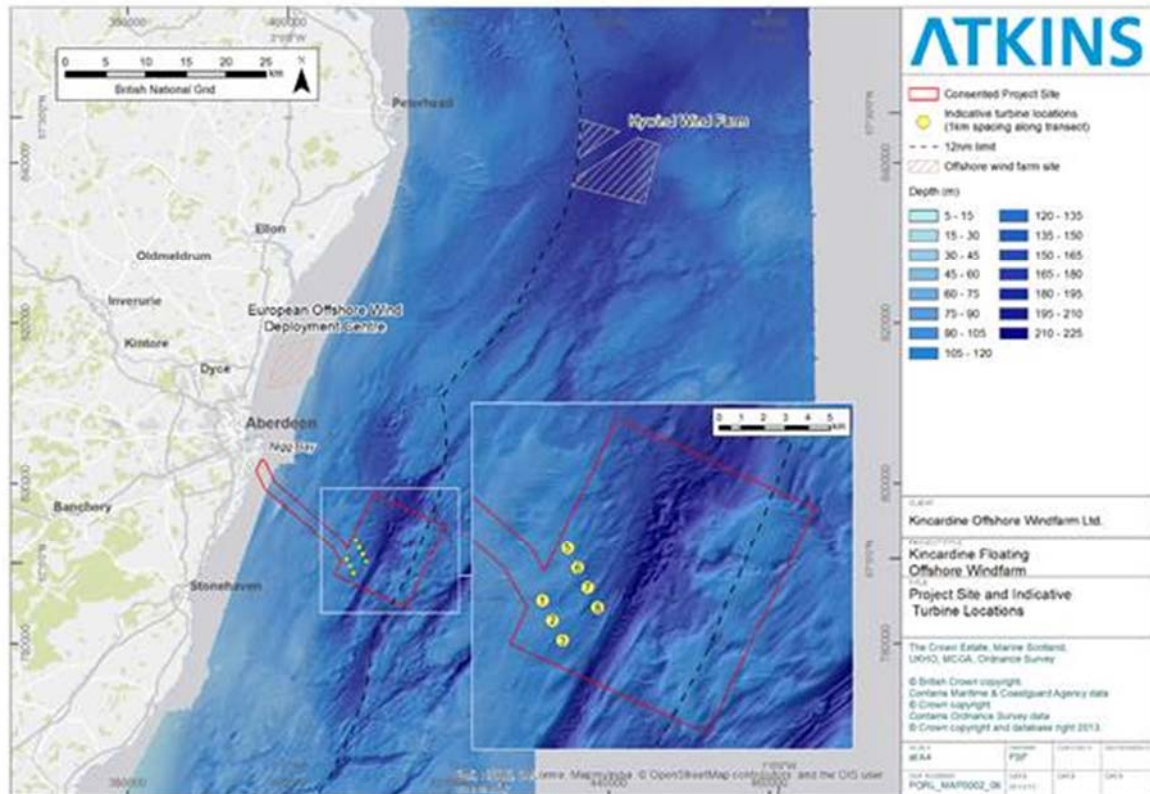



Figure 1-1 Project site and indicative turbine locations

#### 1.4. Approach to Amending and Updating this Cable Plan

This is the first iteration of the CaP (submitted pre-installation of the 2MW WTG and substructure). The nature of the construction process proposed for the Project, see Section 1.3 for details) means that updates to the proposed cable routing and design may be required as the Project progresses.

Where the need for an update or amendment is identified following approval from Marine Scotland Licensing Operations Team (MS-LOT) of the CaP, either through a consultation response, or due to practicalities arising as the project progresses, KOWL will communicate the suggested update/amendment to MS-LOT prior to editing the approved document. If the suggested change is accepted by MS-LOT, the CaP will be redrafted, and submitted for re-approval.

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### 1.5. Consent Conditions

The following consent condition is taken from the S36 Consent which forms the requirements for this CaP.

*Table 1-3 Licence conditions relevant to the CaP*

Licence	Condition Number	Name	Details	Where Addressed in this Document
S36	17	Cable Plan	<p>The Company must, no later than 6 months prior to the Commencement of the Development or at such a time as agreed with the Scottish Ministers, submit a Cable Plan ("CaP"), in writing, to the Scottish Ministers for their written approval. Such approval may only be granted following consultation by the Scottish Ministers with SNH, SEPA, MCA, SFF, Esk DSFB, and any such other advisors or organisations as may be required at the discretion of the Scottish Ministers. The CaP must be in accordance with the ES and ES Addendum.</p> <p>The CaP must include, but not be limited to, the following;</p> <p>a) The location and cable laying techniques for the inter-array cables;</p> <p>b) Technical specification of inter array cables, including a desk based assessment of attenuation of electro-magnetic field strengths and shielding;</p>	<p>a. The planned cable route for the export cables and inter-array cables is shown in Appendix A. The cable laying techniques are described in Section 2.4 and 2.5.</p> <p>b. Details of the cables are provided in Sections 2.4 and 2.5.</p> <p>c. Details are provided in Section 2.6</p>





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		<p>c) A burial risk assessment to ascertain burial depths and, where necessary, alternative protection measures;</p> <p>d) Methodologies for surveys (e.g. over trawl) of the inter array cables through the operational life of the wind farm where mechanical protection of cables laid on the sea bed is deployed;</p> <p>e) Methodologies for inter array cable inspection with measures to address and report to the Scottish Ministers any exposure of inter array cables; and</p> <p>f) Demonstration of avoidance of sensitive periods for relevant bird species during the cable laying works within the intertidal zone.</p> <p>Any consented cable protection works must ensure existing and future safe navigation is not compromised. Scottish Ministers will accept a maximum of 5% reduction in surrounding depth referenced to Chart Datum.</p>	<p>d. Detailed are provided in Section 2.7</p> <p>e. Details are provided in Section 2.8</p> <p>f. Details are provided in Section 2.4.</p> <p>Details of the planned post installation surveys are provided in Section 2.7</p>
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**Links to Other Consent Plans**

The following consent condition is taken from the Marine Licence with which this CaP has linkages to.

*Table 1-4 Licence conditions linked to the CaP*

Licence	Condition Number	Name	Details
Marine Licence	3.2.3.3.	Navigational Safety	The Licensee must ensure that navigable depth is not altered by more than 5% referenced to Chart Datum unless otherwise agreed, in writing, with the Licensing Authority in consultation with the MCA and NLB.

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## 2. CABLE PLAN DETAILS

### 2.1. Cable Routing

The routing of the export and interarray cables have been determined following a range of offshore surveys which have been conducted to ascertain the following aspects:

- Seabed bathymetry;
- Shallow soils composition and makeup;
- Wrecks and debris on the seabed;
- Magnetic anomalies and other hazards;
- Potential Unexploded Ordnance (UXO); and
- Trenching assessment.

The routes for the two export cables are shown in Appendix A are within the Offshore Export Cable Corridor defined in the consented boundary also shown in the drawing, and are close to the preliminary routing as detailed in the Original ES, however the spacing has now been reduced to 50m due to engineering and installation considerations. This does not change any of the assessments undertaken for the Original ES, ES Addendum or Variation ES. The route for the inter-array cables has been defined around the current mooring layouts within the Development Area. There was no indication of potential inter-array routes defined in the Original ES or subsequent ES Addendum and Variation ES.

The results of the geophysical surveys undertaken are also shown in Appendix A, and shows the seabed composition which primarily informed the cable routing. The confirmed locations of identified wreck sites from the geophysical survey undertaken are also shown.

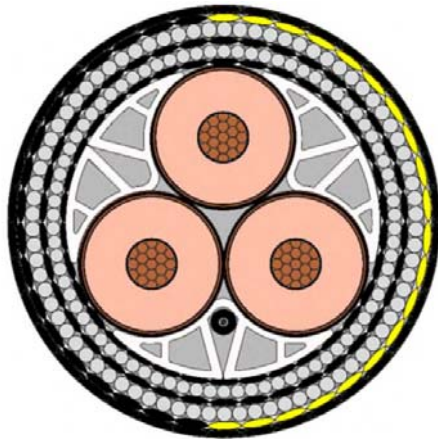
Prior to the commencement of works, the routes defined in this document will be provided to the relevant stakeholders, including the UK Hydrographic Office, followed up with the final as-built positions of the cables post installation.

### 2.2. Hazards and UXO

Assessment of the hazard presented by any potential UXOs along the route is an ongoing process in order to bring the risk As Low As Reasonably Practical (ALARP).

### 2.3. Cable Description

The cable for the export cables and inter-array cables is alternating current (AC) and has a cross-section as illustrated below. The cable is a 19/33(36) rated voltage with a 500mm<sup>2</sup> core area. The outside diameter is nominally 170mm and it has a weight of 57kg/m in air with an estimated weight in seawater of 35kg/m. This is compliant with the type of cable assessed in the Original ES, ES Addendum and Variation ES where applicable.



Description	Details
Conductor	Stranded, round and compacted copper, longitudinally water blocked
Conductor screen	Extruded bonded semi conductive compound
Insulation	EPR
Insulation screen	Extruded bonded semi conductive compound
Screen bedding	Semi conductive screen bedding
Metal screen	Individual Copper Braid screen on each phase
Sheath bedding	Sheath bedding tapes
Power core sheath	Polyethylene sheath
Fillers	Extruded shaped fillers
Binder tape	Synthetic tape for bounding the assembled cores.
1 <sup>st</sup> Armour bedding	Polypropylene Yarns bedding
1 <sup>st</sup> Armouring	One layer of galvanized steel wires, filled with Bitumen.
2 <sup>nd</sup> Armour bedding	Polyester tape + Polypropylene Yarns bedding
2 <sup>nd</sup> Armouring	One layer of galvanized steel wires, filled with Bitumen.
Serving	Polyester tape + Polypropylene Yarns + Polyethylene sheath
OF cable	1 x Optical Fiber Cable with 20SM+4MM fibers, 4SM + 2MM as contingency

*Figure 2-1 Cross section of the 33kv export and inter-array cables*

Due to operating as AC the electromagnetic field (EMF) will be significantly less than for a DC cable, due to the field largely being cancelled out. The cable to be used is double-armoured whereas it was assumed in the ES that it would only be single armoured. The conductivity of the double armouring arrangement affects the EMF resulting in reduced field strength.

The impact of the EMF field is under assessment, based on the target depth of burial (see Section 2.6) and soils anticipated to be expected along the route and maximum operational load through each cable. Further details will be provided when available.

The proposed routes for the export cables are shown in Appendix A. The lengths are provided in the table below.

*Table 2-1 Length of Export Cable 1 and 2*

Export Cable Number	Length (m)
Export Cable 1	17,100
Export Cable 2	18,500

The inter-array cables will only be installed prior to Tranche 2. The layout provided in the Appendix A is only indicative at this stage, and a final layout will be provided prior to the commencement of Tranche 2. There is a total of six inter-array cables, five of which are approximately 1.2km in length and a single cable of approximately 3km in length. It should be noted that the cables will be in a buoyant wave configuration prior to entering the turbine and hence the plan distance of the cable route will be slightly less. The exact length of each cable will be confirmed once the final seabed micro-routing has been completed.

#### **2.4. Cable Laying – Export Cables**

The export cable installation will be performed using a dedicated cable installation vessel, which will setup offshore to feed out the cable as it is pulled up the HDD to the onshore location. The cable will

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then be laid completely, prior to commencing trenching operations. The installation methodology will be the same for both export cables regardless if they are laid at the same time or not.

Installation and trenching of the Export Cable 1 (and possibly Export Cable 2 is planned for June 2018 (an extract from the Construction Programme (KOWL-REP-0004-001) has been included below) which avoids sensitive periods for smolts (April and May). It is also noted that in the condition it is required that sensitive periods for relevant bird species should be avoided in the inter-tidal zone. As there is no inter-tidal zone work that will be affected by the Project, it is not considered necessary to avoid any periods for bird species. It is noted that the timings presented below for installation are longer than that assessed in the Original ES (five days), however, the methodology for installation has not changed and therefore there is no change to the predicted significance of impact from this activity.

*Table 2-2 Extract from the detailed Construction Programme for the export cable installation activities*

Activity	Start Date	Finish Date	2018											
			F	M	A	M	J	J	A	S	O	N	D	
<b>Export Cable 1 Installation</b>	<b>28/05/2018</b>	<b>01/07/2018</b>												
Boulder Clearance	28/05/2018	08/06/2018												
HDD Pull-In and Surface cable lay	20/06/2018	22/06/2018												
Cable Trenching	23/06/2018	01/07/2018												

## 2.5. Cable Laying – Inter-Array Cables

The inter-array cables will be arranged as illustrated the Site Layout Plan shown in Appendix A, routing around the mooring lines. The cable will be installed between each turbine and consist of buoyancy modules in the area close to the turbine in order to generate a “lazy wave” profile. This profile will be within the mooring pattern of the turbine.

As installation of the inter-array cables is scheduled for August 2019, details of the methodology are not known at this time, and this will be updated in a future iteration of this document.

## 2.6. Cable Burial

Based on the geotechnical investigations performed trenching of the export cables may prove difficult along certain section, in particular around 5km and 9km from the shore. Further details will be provided following the detailed cable burial risk assessment to be performed by the cable installation contractor.

The burial operations will be conducted using a combination of jet and cutting configurations due to the variability of the soils along the route. The trenching is expected to be performed using the Canyon Offshore i-Trencher as shown in Figure .




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Figure 2-2 Canyon Offshore i-Trencher / T1200 Jet Trencher (courtesy Canyon Offshore)

The target depth of burial of the cable will be 1.5m. Due to local seabed conditions this burial depth may be exceeded and in some areas not achieved; henceforth why it is termed a “target” burial depth. If the minimum depth of burial of the cable is not achieved consideration will be given to protection in the form of rock dumping or concrete mattresses in the localised areas. A risk assessment for the cable will be carried out prior to the remedial work (rock dumping or concrete mattresses) is undertaken and following discussion with MS LOT.

The inter-array cables are not planned to be trenched, unless required for physical stabilisation on the seabed. The exception to this may be the cables which have significant length outside of the anchor pattern between turbines.



### 2.7. Post Lay Survey

The position and depth of the export cables will be measured following all trenching operations. The survey normally consists of a ‘Work Class’ Remotely Operated Vehicle (WROV) with a pipe tracker system (typically TSS-440) which records the depth of the cable. In addition, the profile of the seabed either side of the trench (including the trench and any material to the side) will be recorded using profiling sonars.

Using the position and depth of the WROV the information is post-processed on-shore to generate the as-built / as-trenched survey charts, graphs and images which can be compared against in future surveys.

One of the requirements within the Section 36 Consent is that there should be a maximum reduction of 5% of water depth referenced to chart datum following cable protection works. This is also referred to in the Condition 3.2.3.3 of the Marine Licence (Navigational Safety). This represents an increase in seabed height of 0.75m in 15m of water depth. A water depth of 15m is expected to be the shallowest water depth for trenching and typical berms heights either side of a trenching operation are expected to be less than 0.75m, reducing as the material backfills into the trench under the action of waves and current.



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**2.8. Operational Inspections**

The operational inspection of an export cable is difficult to perform due to the cable being buried and hence remote monitoring of the cable. The fibre optic core allows historical monitoring of the cable temperature and strain. Any changes can indicate effects such as increased or reduced burial depth and identify the position on the cable

Where additional protection is applied to the cable the monitoring of the stability of any such rock dump can be performed by visual inspection by WROV and comparison with the previous survey data, to establish the stability and hence continuity of cover over the cable.

For the inter-array cables, they are mostly unburied and near to the turbine held in a lazy-wave profile. These sections will undergo a visual monitoring for damage and any change of position using well established WROV techniques.

Further information on the surveys to be undertaken during the operational phase will be provided in the Operation and Maintenance Programme. When more information is known on the methodologies to be used, this CaP can also be updated.

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### 3. COMPLIANCE WITH APPLICATIONS AND ASSOCIATED ENVIRONMENTAL STATEMENTS


The final design and installation of the export cables and inter-array cables for the Project requires compliance with the parameters defined the Original ES and ES Addendum and Variation ES where applicable as stated in the wording of the condition in Section 1.5. The worst-case scenario for the export cables and inter-array cables outlined in the Original ES remained unchanged for the ES Addendum and Variation ES and therefore this section refers to the parameters set out in the Original ES.

This Section sets out information from the Original ES regarding compliance with the export and inter-array cables.

#### .1. Compliance with the Original ES, ES Addendum and Variation ES

The Original ES set out the specifications and parameters which are to be applied during in the installation of the export cables and inter-array cables, this took the form of a 'Rochdale Envelope'. In order to demonstrate compliance with the Original ES, the cable parameters considered are compared with the cable parameters set out in this CaP.

The embedded mitigation measures, as described in the Original ES, have been maintained as much as possible within the technical requirements of the Project. The embedded mitigation measures included in the Original ES are outlined in Table 3-1 below.

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**Table 3-1 Embedded Mitigation**

Embedded Mitigation	Reference Chapter) (ES	Where Addressed in this CaP
Export cables will be buried to a target depth of 1.5m or will be protected by other means when burial is not practicable, this will help to reduce the risk of snagging fishing gear	Commercial Fisheries	Section 2.6
Export cables will be buried to a target depth of 1.5m or protected by other means when burial is not practical.	Benthic Ecology	Section 2.6
Export cable will be buried to a target depth of 1.5m in accordance with DECC Guidelines (2011) which will reduce the potential for impacts relating to EMF	Fish and Shellfish	Section 2.6
Cables will be specified to reduce EMF emissions as per industry standards and best practice such as the relevant IEC (International Electrotechnical Commission) specifications	Fish and Shellfish	Section 2.3
Export cables will be buried to a depth of 1.5m or protected by other means where burial is not practicable, e.g. rock dumping or concrete mattresses, which will reduce potential for impacts relating to Electromagnetic Fields (EMF)	Marine Mammals	Section 2.6

### **Export Cables**

In the Original ES and ES Addendum mitigation measures relevant to the installation of the export cables are detailed below

Table 3-2 presents a comparison of the consented project parameters relevant to the installation of the export cables as set out in the Original ES against the details set out in this CaP.

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**Table 3-2 Compliance with Rochdale Envelope Parameters defined in the Original ES**

<b>Construction Parameter</b>	<b>Related</b>	<b>Parameter Defined in Original ES</b>	<b>Parameter Defined in CaP</b>
Number of Export Cables		2	2
Total Length		19km (per cable)	Up to 19km (per cable)
Length Offshore		15km	15km
Cable outer diameter		180mm	Nominally 170mm
Installation method offshore		Trenching, laying and burial	Trenching, laying and burial
Trench width per cable		3m	Unknown at this time but not expected to be >3m
Trench depth		1.5m	Target depth of 1.5m
Separation distance between cables		500m	50m
Rated capacity		33kv	33kv
Burial at landfall		HDD	HDD
Burial offshore if 1.5m depth not achieved		Rock dumping in trench to bury cable if the sediment removed from trench does not provide sufficient material to bury the cable. Max anticipated 10% of cable length, 1.5km each cable therefore total 3km.	Further details will be provided following the detailed cable burial risk assessment.  Rock dumping in trench to bury cable if the sediment removed from trench does not provide sufficient material to bury the cable
Scour protection		None considered – to be monitored during operational phase	Further details will be provided following the detailed cable burial risk assessment if necessary.

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Installation	1 vessel, 2 days transit and 3 days of operations = 5 days total for both cables	1 vessel, 9 days in total for cable trenching (per cable)
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### Inter-array Cables

As installation of the inter-array cables is scheduled for August 2019, details of the methodology are not known at this time, therefore Table 3-3 will be updated in a future iteration of this document.

Table 3-3 presents a comparison of the consented project parameters relevant to the installation of the Inter-array cables as set out in the Original ES against the details set out in this CaP.

**Table 3-3 Compliance with Rochdale Envelope Parameters defined in the Original ES**

Construction Parameter	Related	Details of Commitment	Implementation
Number of inter-array cables		12	6
Length		2.5km each, total 30km	TBC
Cable outer diameter		180mm	180mm
Total area of seabed coverage		5400m <sup>2</sup>	<5400m <sup>2</sup>
Rated capacity		33kv	33kv
Installation		Laid on seabed	Laid on seabed
Burial		None anticipated, burial during installation if deemed necessary post further surveys prior to installation. Max 10% of total length buried considered for EIA 3km (540m <sup>2</sup> )	TBC before Tranche 2
Scour protection		None considered	TBC before Tranche 2
Installation		1 vessel, 1 day transit, 13 days of operations = 14 days	TBC before Tranche 2

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