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SCOTTISH HYDRO ELECTRIC POWER DISTRIBUTION PLC

Project Description

Jura to Islay Distribution Cable Replacement

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Intertek Energy & Water Consultancy Services
Exchange House, Station Road, Liphook, Hampshire GU30 7DW, United Kingdom

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Project Description

Jura to Islay Distribution Cable Replacement

Authors

Aodhfin Coyle, Patricia Elder

Project Manager	Authoriser
Patricia Elder	Eric Houston

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Rev 2	19/10/2023	Final Submission	AC	PE	JEH

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GLOSSARY

GLOSSARY

AToN
Aid to Navigation

BS
Basking Shark

CBRA
Cable Burial Risk Assessment

CEMP
Construction Environmental Management Plan

CLV
Cable Lay Vessel

CPSP
Cable Protection and Stabilisation Plan

CR
Client representation

DP
Dynamic Positioning

DSV
Dive Support Vessel

DTS
Desk -top Study

DWA
Double Wired Armour

EPS
European Protected Species

FLMAP
Fisheries Liaison Mitigation Action Plan

FO
Fibre Optic

GPS
Global Positioning System

HDD
Horizontal Directional Drilling

HVAC
High Voltage Alternating Current

Kg
Kilograms

Kg/m
Kilogram per metre

kV
Kilovolt

LAT
Lowest Astronomical Tide

m
Metre

MBES
Multibeam Echosounder

MEA
Marine Environmental Appraisal

MHWS
Mean High Water Springs

MLWS
Mean Low Water Springs

MM
Milometers

mm^2
millimetre squared

NAVTEX
Navigational telex

NTM
Notice to Mariners

OBS
On-Bottom Stability

OCT
Open Cut Trench

OiC
Ocean I.Q

OoS
Out of Service

PLGR
Pre-Lay Grapnel Run

ROV
Remotely Operated Vehicle

RPL
Route Position List

SBP
Sub-bottom Profiler

SDS
Safety Data Sheet

SEPA
Scottish Environment Protection Agency

SHEPD
Scottish Hydro Electric Power Distribution plc

SIMOPs
Simultaneous Operations

SLD
Straight Line Diagrams

SSEN
Scottish & Southern Electricity Networks

SSS
Side Scan Sonar

Tn
Tonne

TJP
Transition joint pit

UKHO
United Kingdom Hydrographic Office

USBL
Ultra Short Baseline

UXO
Unexploded Ordnance

WD
Water Depth

WTN
Waste Transfer Note

3D
Three Dimensional

1. INTRODUCTION

1.1 Overview

Scottish and Southern Electricity Networks (SSEN) operating under licence as Scottish Hydro Electric Power Distribution plc (SHEPD) is responsible for monitoring and maintaining the efficiency and integrity of the subsea electricity cable networks which provide power supplies to 60 Scottish islands.

A single 33kV subsea electricity cable across the Sound of Islay connects the islands of Islay and Jura to the electricity distribution network. The existing Jura - Islay subsea cable is the sixth cable which has been laid in this location. Previous installations were in 1961, 1966, 1975, 1986, 1998 and 2011. Across the five previously installed cables, prior to 2011 there were five recorded faults which could be found in historic records, all of which have been noted as abrasive wear. The 2011 cable, to date, has not experienced any faults but has been recorded as being in a critical condition following visual inspections in April 2021, with multiple areas of armour damage identified, and as such this cable has been identified as requiring urgent replacement.

This project description sets out the methodology proposed to undertake the cable replacement works. The works are scheduled to take place in between 01 April 2024 and 31 October 2025. The estimated time period for each activity is presented below in Table 1-1.

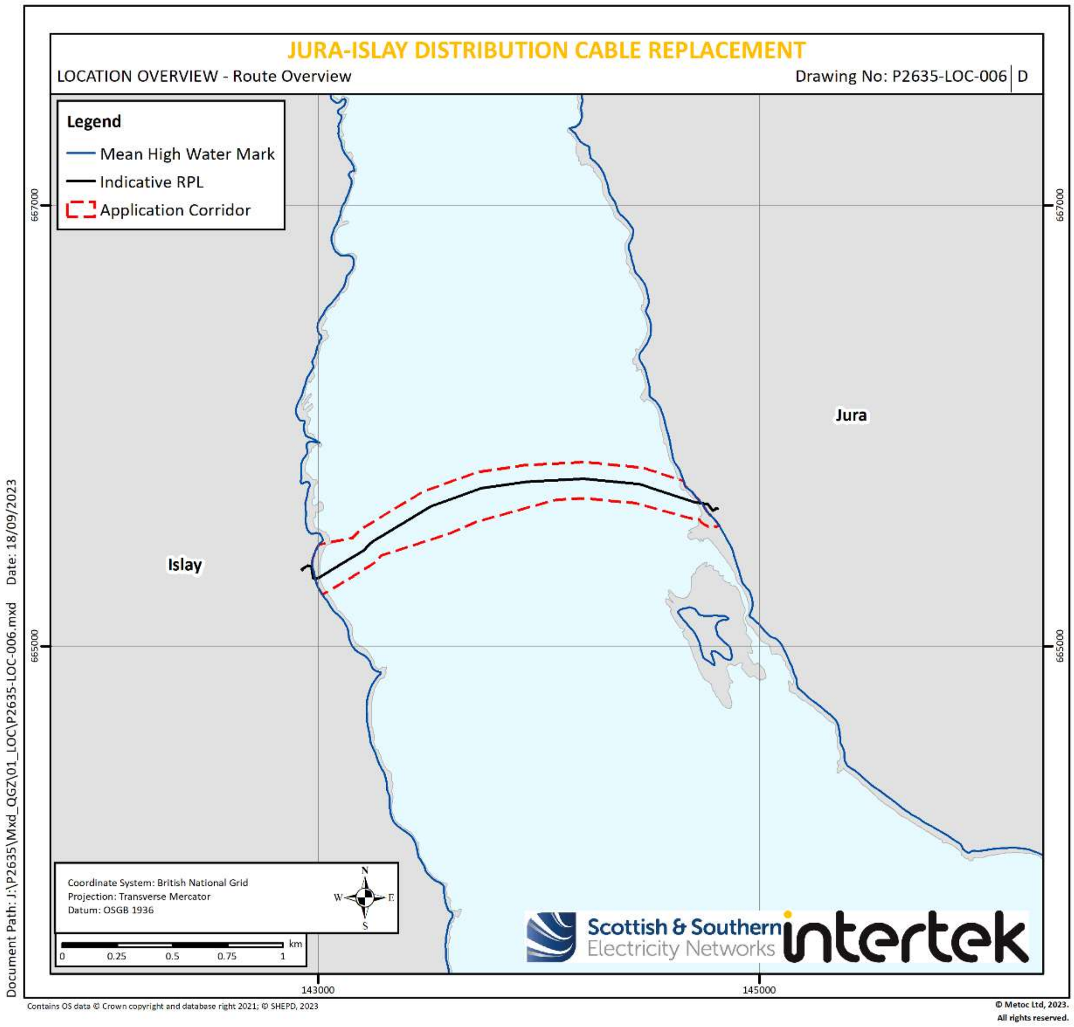
Table 1-1 Estimated installation schedule

Activity	Estimated time period (Days)
Route Clearance and Pre-lay grapnel run	6 days
Shore-end pull into Jura and Islay, and cable burial	10 days
Offshore installation including, cable crossing, offshore install and stabilisation	9 days
Pre and post-lay inspection	2 days

1.2 Replacement cable corridor

The Application Corridor for the replacement cable is shown in red in Figure 1-1 (Drawing reference: P2635-LOC-006). The Application Corridor within which the cable will be installed is 150 meters (m) wide (+/- 75m either side of the route centreline). The Marine Licence Application is for installation of the replacement cable within the boundary of this Application Corridor.

Figure 1-1 Jura to Islay Cable Installation Application Corridor (P2635-LOC-006)



1.2.2 Cable route design

OceanIQ (OiQ) were commissioned by SHEPD to undertake a Cable Route Desktop Study (DTS) (Report reference: 3935-GMSL-G-RD-0001). This study presents the potential risks to the replacement cable along the entire route and the alternative routes that have been considered and provides a summary of the perceived issues with each cable route with respect to engineering and installation of the cable. OiQ have developed Route Position Lists (RPLs) and Straight-Line Diagrams (SLDs) that comprise the compound knowledge gained from data collected by SHEPD and OiQ research. The route has been designed to ensure cable security and prevent loss of service. The recommendations of the report concluded the following:

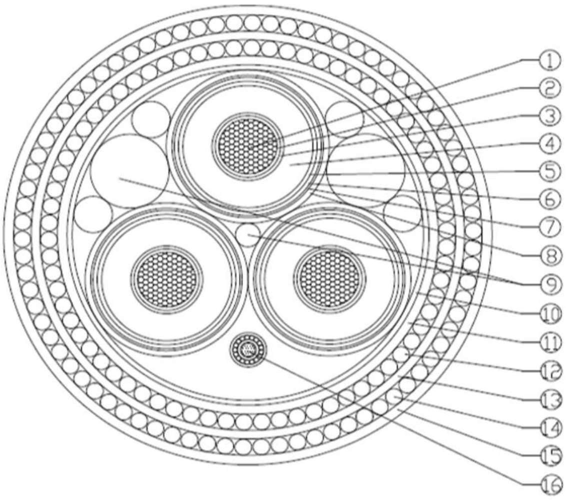
- Surface lay the cable across route due to the lack of sediment available for burial. Protect the shore ends at Islay to 10m Lowest Astronomical tide (LAT)) and 14m LAT at Jura with articulated pipe and assess the optimum amount of rock bags required to stabilise the cable, post embedment analysis.
- Review the cable route and additional protection methods required during, and following the marine survey to optimise security, with particular attention to traces of ship anchoring and fishing activity from scars detected by side scan sonar.

- Ensure any areas of mobile sediment along the route are captured during the marine survey and determine the depth of sediment cover over bedrock across the route.
- Undertake a benthic assessment of the cable route during the geophysical survey to assess if the habitats noted in the nearby proposed Demonstration Tidal Array area (operated by Oran na Mara Ltd) are also noted in, or around, the cable route.
- Undertake a marine offshore liaison program with fishing groups before, during and after installation to reduce the chances of damage to the cable.
- Perform marine survey and main cable lay during the annual good weather window from April to September.
- Once the cable route survey is completed use the resulting data to revise the RPL to further minimise the rock outcrops and boulders crossed by the cable.
- Make sure that the installed cable is marked on navigation charts.

2. PROPOSED CABLE PROTECTION

Electricity will be transmitted using High Voltage Alternating Current (HVAC) submarine cable technology. The typical cable structure is shown below in Figure 2-1.

Figure 2-1 Typical XLPE HVAC submarine cable structure - cross sectional drawing



1 Copper stranded conductors
2 Semiconductive waterblocking tape
3 Non-metallic screen
4 XLPE insulation
5 Non-metallic screen
6 Semiconductive waterblocking tape
7 Metallic screen
8 HDPE sheath
9 Non-hydroscopic fillers
10 Binding tape
11 PPY separator layer
12 Inner layer of galvanized steel armouring
13 PPY separator layer
14 Outer layer of galvanized steel armouring
15 PPY outer layers
16 Fibre optic

Source: SSEN 2022

The subsea cable that is proposed for installation is a 33kV Hellenic 185mm^2 three core XLPE conductor with a fibre optic (FO) cable, encased and protected with a double layer of 6mm steel wire armour. The proposed double wired armour (DWA) construction will provide the cable with additional mechanical protection and weight thus providing additional stability for the surface laid cable.

FOs are installed integral to the submarine cable for the purpose of cable condition monitoring, control and power system protection.

The subsea cable conductor cores specification and power rating has been selected through the assessment of historic demand on the existing network and with consideration given to future demand growth on the network.

A summary of the key mechanical properties of the replacement cable is provided in Table 2-1.

Table 2-1 Proposed cable – key mechanical properties

Cable Weight (in Air) kg/m	Max Tension (kN)	MBR (m)	Cable Diameter (mm)	Max Crush Resistance (kN/m)	Specific Gravity
39.3	110	2.00	132.4	20	3.2

Prior to installation, dynamic simulations using OrcaFlex or similar software will be run of the proposed installation methodology, taking into account the mechanical parameters shown in Table 2-1. The outputs of this analysis will be a set of operational weather parameters that the installation will adhere to.

An On-Bottom Stability (OBS) assessment will be conducted to ascertain whether the cable will be stable on the seabed for its design life, and if not, what additional stability measures may be required.

3. ROUTE ENGINEERING SURVEY

Route Engineering survey works were undertaken between February and July 2023 and included the following:

- Offshore geophysical survey.
- Offshore environmental survey.
- Nearshore geophysical survey.
- Landfall topographic survey.
- Intertidal ecological survey.

The key outputs of the surveys were as follows:

- Seabed bathymetry and land topography.
- Drop-down Camera inspection to support classification of existing marine habitats.
- Identification of archaeological features along the proposed cable route.
- Identification of hazards (debris, existing cables etc.) along the route.

The survey works have informed selection of the Application Corridor. The data was used to engineer the route for this replacement cable.

The survey works have also informed the environmental assessment provided in this Marine Environmental Appraisal (MEA) report (Report reference: P2635_R6196).

4. CABLE PROTECTION AND STABILISATION

4.1 Overview

A Cable Protection and Stabilisation Plan (CPSP) has been developed based on preliminary survey data acquired from the nearshore and offshore survey vessels, see Table 4-1 below. The CPSP conservatively outlines the type and number of seabed deposits and is the basis of the assessment undertaken in the MEA.

Engineering studies are ongoing which may alter the final quantity of deposits required and where possible, these will be optimised in the detailed design such as to minimise the overall footprint of the Project. For example, the use of fewer, larger rock bags could be considered where the footprint could be reduced and required stabilisation achieved. The information provided in the CPSP and assessment in the MEA is therefore based upon worst-case scenarios. More information on the type of protection and stabilisation that could be used is provided in Section 5.6.

4.2 Cable protection and stabilisation

Table 4-1 conservatively outlines the type and number of seabed deposits.

Table 4-1 Cable protection and stabilisation

Type of deposit/ removal	**Deposits**		**Removal**	
	Description	**Quantity & Dimensions (metric)**	**Description**	**Quantity & Dimensions (metric)**
Cast Iron split pipe	Articulated cast iron shell design that interlocks around the cable and is fixed with bolted end clamps. This will be placed on either shore end of the cable where burial is not possible.	Quantity No. 2833	N/A	N/A
		Dimensions: Diameter: 260mm Length of each shell: ~330mm		
		Weight: 51.3kg/m		
Uraduct	Plastic/synthetic cable protection.	Dimensions: Length: 350m	N/A	N/A
Concrete mattresses	Concrete mattresses may be required to stabilise the cable and/or manage cable crossings.	Quantity: No. 10	N/A	N/A
		Dimensions: Width: ~3m Length: ~6m Height: ~0.3m		
		Weight 8.75 T each		
Rock bags (MLWS -10m LAT)	Rock bags may be required to stabilise the cable between MLWS and 10m LAT.	Quantity: No. 96	N/A	N/A
		Dimensions:		

Type of deposit/ removal	Deposits		Removal	
	Description	Quantity & Dimensions (metric)	Description	Quantity & Dimensions (metric)
		Diameter: ~2.2m Height: ~0.4m Weight: ~2T each		
Rock bags (below 10m LAT)	Rock bags may be required to stabilise the cable below 10m LAT.	Quantity: No. 164 Dimensions: Diameter: ~ 2.8m Height: ~0.6m Weight: ~4T each	N/A	N/A

5. PROJECT DESCRIPTION

5.1 Proposed route

The proposed replacement cable route has been assessed from an engineering perspective in a number of desktop study reports. These include the Cable Route DTS (QiQ Report Reference: 3935-GMSL-G-RD-0001), Horizontal Directional Drilling (HDD) DTS (Mott MacDonald Report Reference: 07236-MMD-00-XX-M3-Z-0001), Jura to Islay Desk Study Report (ERM Report Reference: 0646770), various marine survey reports, and fisheries considerations outlined as part of the Fisheries Liaison Mitigation Action Plan (FLMAP) Argyll.

The location of the replacement cable in relation to existing infrastructure is shown in Figure 1-1 (Drawing reference: P2635-LOC-006). The cable routing decisions taken as part of the development of the route are outlined in Section 5.1.1.

5.1.1 Route decision making process

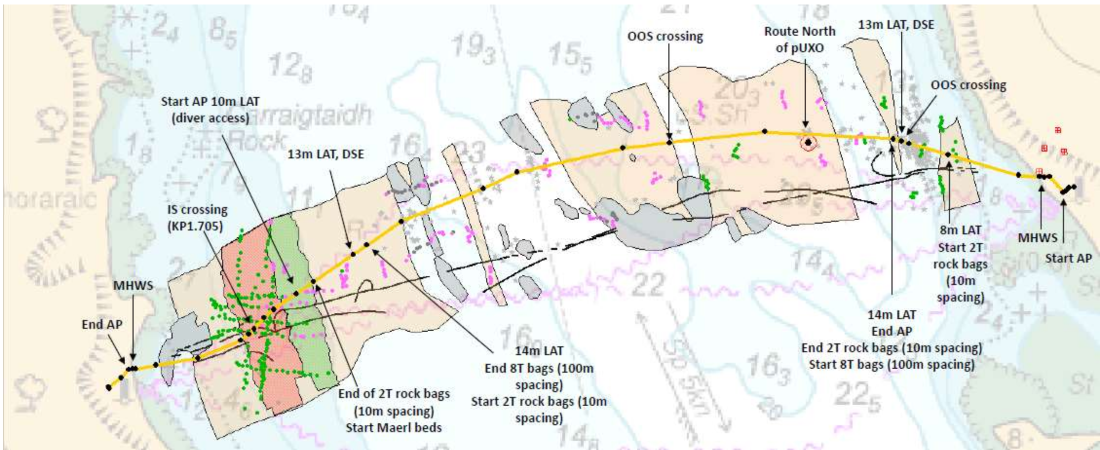
Table 5-1 Key route engineering

Stage	Date	Description
Desktop Study Route (prior to survey work)	October 2022	Preliminary RPL based on existing site data and publicly available information
In-field selected route	June 2023	Updated infield selected route from preliminary survey vessel deliverables
Post survey and route engineering works	September 2023	RPL for cable installation generated from geophysical and geotechnical survey data and cable burial risk assessment

5.1.2 Route description

The proposed Application Corridor lies between Jura and Islay as shown in Figure 1-1; the recommended route is presented in Figure 5-1.

Figure 5-1 Recommended route, with existing operating cable and out of service cable



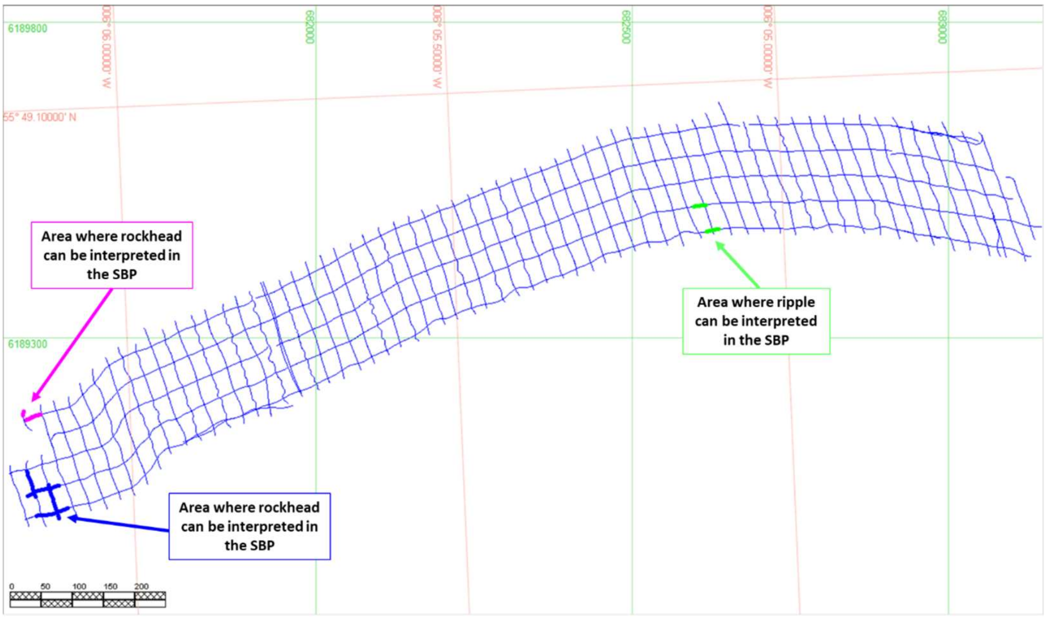
Source: Ocean IQ, 2023

The survey corridor for the replacement cable covered an area of approximately 0.314km^2 comprising a corridor 2,094m long by 150m wide. The survey corridor was selected to avoid key seabed features where possible and to maximise the amount of survey data available to inform route engineering decisions.

A bathymetric overview of the Sound of Islay is presented in Figure 5-5 (Drawing no. P2635-BATH-001). Where possible the cable route has been optimised to allow for efficient installation and the least disruption to the seabed and designed to avoid as much outcropping rock as possible. The route has been designed to utilise expected areas of granular seabed sediments and in time the cable is expected to self-embed within these sediments, as the existing cable has.

A geophysical survey was undertaken in April 2023 by 'Aspect Land and Hydrographic Surveys'. An Innomar SES2000 compact Sub Bottom Profiler (SBP) was used to survey the Application Corridor. A lack of coherent acoustic signal below the seabed prevented interpretation of geological features over the whole survey area and only localised observations were made. Figure 5-2 shows three small, separate areas where some geological features could be observed.

Figure 5-2 Sub-bottom profile survey lines



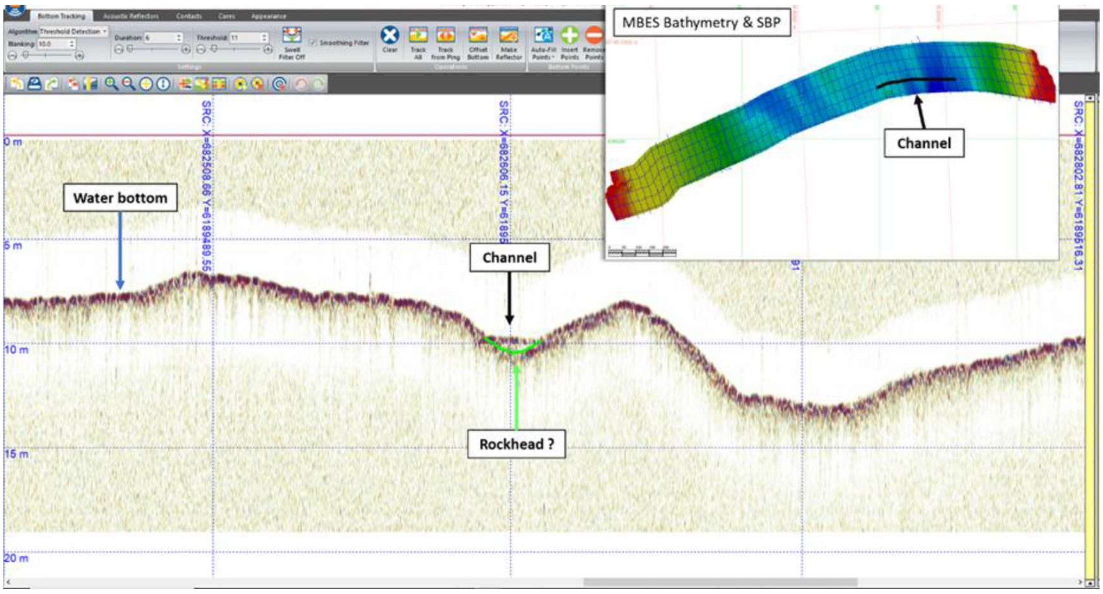
Source: Aspect, 2023

The cable route will be located within the boundary of the Application Corridor and commences at the Transition Joint Pit (TJP) Easting:683259, Northing:6189496 on the beach north of Glas Eilean on the island of Jura and runs along the rocky foreshore and across the seabed in the Sound of Islay and onto the beach to the north of the existing cable to the TJP (Easting: 681415, Northing: 6189030) in Tràigh Bhàn on Islay. The route from TJP to TJP is described in an east to west direction below.

Commencing at the TJP, on the beach to the north of Glas Eilean on Jura, the cable route crosses the rocky foreshore onto the beach. This is to the north of the existing distribution cable. The nearshore/intertidal area is dominated by surface and shallow rock, the cable will be routed to cross the shortest distance over this rocky area. The cable route continues offshore in an area which is dominated by sands and shallow rock to the north of the existing cable.

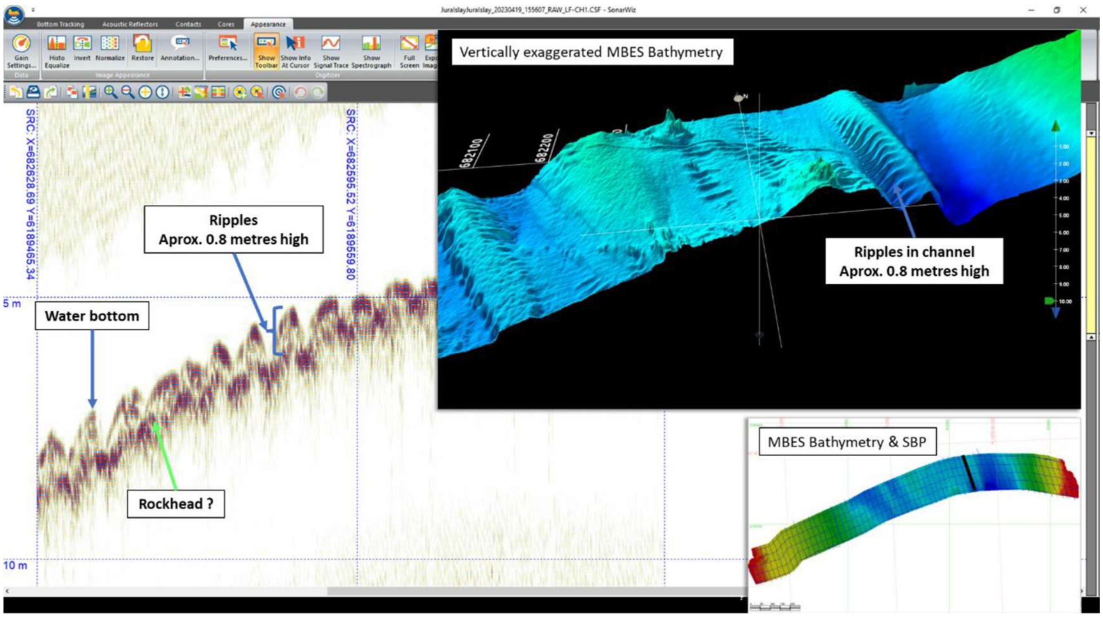
An area of sand ripples, approximately 0.8m high and confined to a narrow channel, were observed at a localised interpretation area to the east (denoted in green in Figure 5-2). The bathymetry data shows ripples in several other areas however, they are not as high as the ones in the confined narrow channel (Figure 5-3 and Figure 5-4).

Figure 5-3 Ripples observed on the Jura side of the Application Corridor



Source: Aspect, 2023

Figure 5-4 Bathymetry review of ripples



Source: Aspect, 2023

The route passes through areas of mobile seabed before crossing the existing Jura to Islay cable to the south. The cable route then continues toward the shore on Islay keeping to the south of the existing distribution cable.

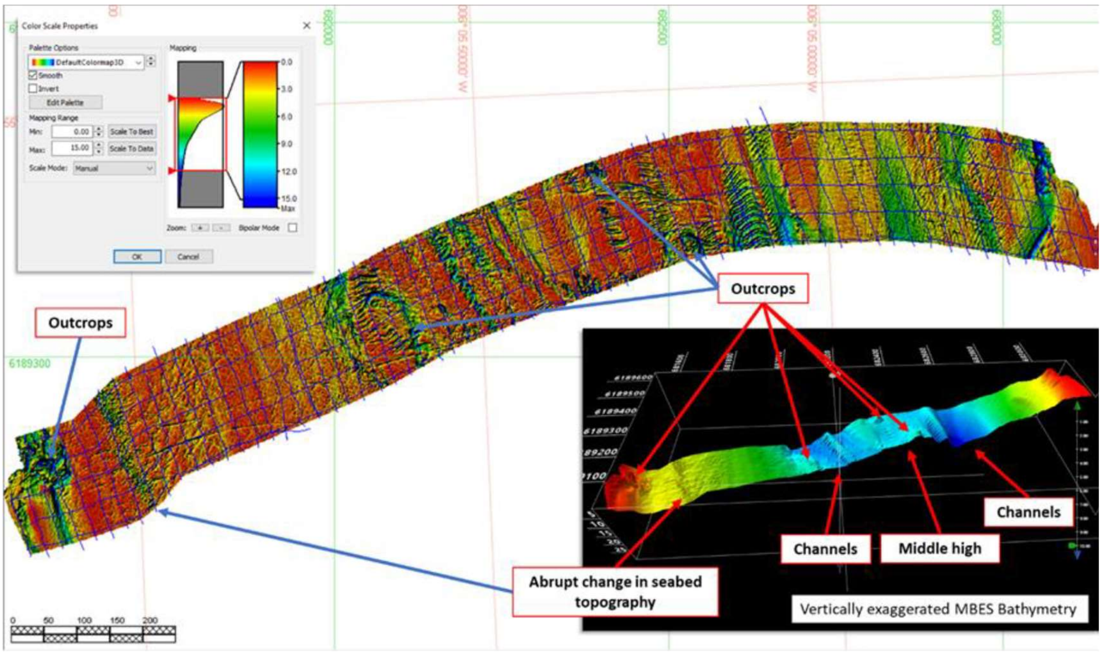
A second feature with localised interpretation is located to the west, after the cable route crosses the existing in-service cable, close to the Islay shoreline (denoted in pink in Figure 5-2). On the most northerly profile an acoustic reflector can be interpreted.

A third feature of localised interpretation, found after the cable crossing is located to the south of the Islay side of the Application Corridor (denoted in blue in Figure 5-2). The SBP indicates a slightly dipping event below a pillow shape on the seabed. On review of the bathymetry in those two areas outlined above (delineated in pink and blue in Figure 5-2), the seabed has a smoother appearance compared to its surroundings. This may indicate soft sediments and therefore can be interpreted as rockhead. Also, it should be noted that these two areas are separated by a protruding seabed feature.

An area of surface rock is crossed within the intertidal area on Islay, again over the shortest distance feasible, before routing southwest to the TJP and following a similar trajectory to the existing cable.

Figure 5-5 below shows a slope map of the bathymetry data. It shows that the Jura shoreline is slightly steeper than the Islay shoreline. The bathymetric data shows that there is a high flank by north-south channels. There are two possible outcrops delineated by steep and semi-circular features on the slope map in Figure 5-5. Two more possible outcrops are also observed to the west of the high and there is also an abrupt change in seabed topography approaching Islay.

Figure 5-5 Bathymetric slope map of the Application Corridor

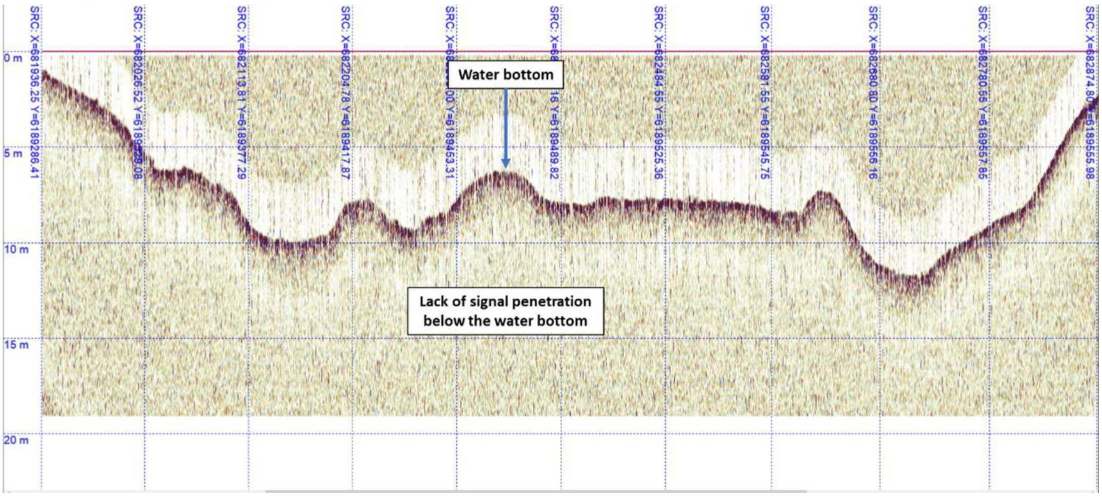


Source: Aspect, 2023

5.1.3 Route corridor profile

A profile of the topography and seabed along the cable route is presented in Figure 5-6:

Figure 5-6 Seabed profile along the Jura to Islay cable route



Source: Aspect, 2023

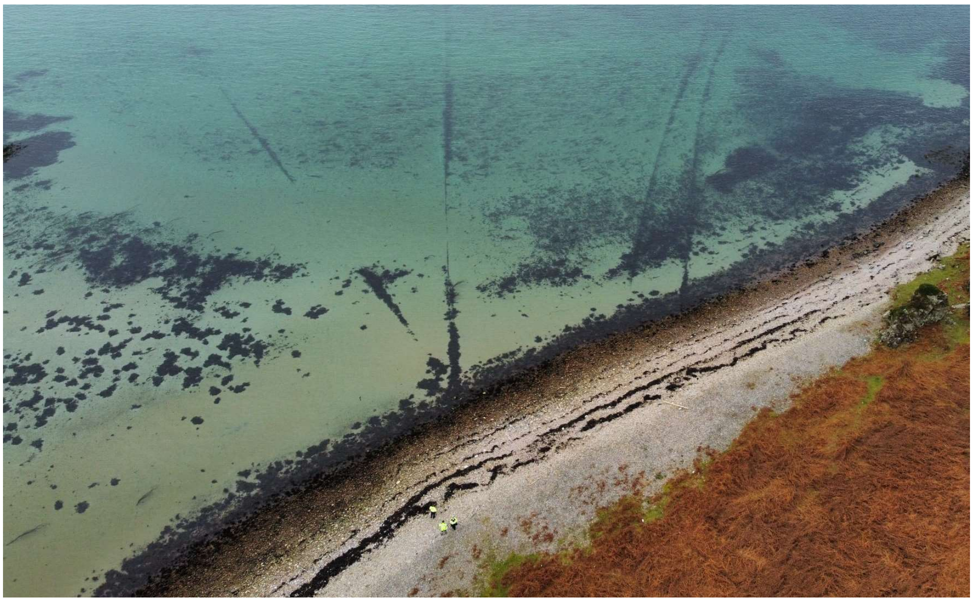
5.1.4 Proposed Jura landing site

It is planned to utilise the landing site of the existing power distribution cable at the beach north of Glas Eilean on Jura. A site visit was undertaken by SHEPD in January 2022 and the following points were outlined in the Site Report:

- Site access track may need to be installed, along with parking. The nearest public road is the A846, a single lane tarmac road with passing places. Whilst this is the closest road to the landing point, access would need to be made over almost 900m of moorland from the road. A landing craft is being considered to bring in some of the plant, to reduce the site access track requirements.
- The presence of several OoS submarine and land cables should be expected. Terminal poles may be upgraded; however this will be within the existing line.

Overall, this site is the most cost-efficient location as the replacement cable will connect into existing infrastructure. Another advantage of this site is the nature of the marine approach, with close access for a cable lay vessel and a relatively benign seabed in the central portion of the bay. In selecting this landing site, consideration was also given to the effects of coastal erosion and the route of the current operating cable. Figures 5-7 to 5-9 show the Jura landfall location, taken during the SHEPD site visit in January 2022.

Figure 5-7 Jura existing landfall



Source: SSEN, 2022

Figure 5-7 shows an aerial view of the existing landfall on the island of Jura, this image was taking on a drone in landscape orientation during the SHEPD site visit (January 2022). The image shows existing cables that make landfall on the Isle of Jura.

Figure 5-8 Jura existing tie-in-to network

Source: SSEN, 2023

Figure 5-8 shows the existing electricity network on the Isle of Jura, this image was taking during the SHEPD site visit (January 2022). The image shows electricity poles in the distance, and SHEPD employees at the proposed Jura landing point.

Figure 5-9 Jura existing landfall beach

Source: SSEN, 2023

Figure 5-9 shows the narrow beach at Glas Eilean on the island of Jura, this image was taking from a drone during the SHEPD site visit (January 2022).

5.1.5 Proposed Islay landing site

The Islay landing site also utilises the current power distribution cable landing site at Tràigh Bhàn, Islay. This site was also visited by SHEPD in January 2022, during which the following considerations for selecting this site were identified:

- Reinforcement of some of the tracks to make suitable for plant equipment may be required.
- A landing craft is being considered to bring in some of the plant, to reduce the site access track requirements.
- Presence of several OOS submarine and land cables should be expected.
- Connection to the grid can be made via existing terminal pole which is close to the shore landing.
- Terminal poles may be upgraded; however this will be within the existing line.

This presents the most cost-efficient solution for SHEPD and the new distribution cable. A further advantage of the site is the nature of the marine approach with close access for a cable lay vessel and a relatively benign seabed particularly through the small gap in the surrounding rocks.

Figures 5-7 to 5-9 show the Islay landfall location, taken during the SHEPD site visit in January 2022.

Figure 5-10 Islay landfall site

Source: SSEN, 2023

The rock outcropping and stony patches which almost surround the bay can be seen in historical aerial imagery and the SHEPD site visit (January 2022) image in Figure 5-10 due to the excellent water clarity. Beyond the surrounding rock further areas with a thin covering of finer sediments exist.

Figure 5-11 Existing aid to navigation & termination pole

Source: SSEN, 2023

Figure 5-11 shows access to site is entirely through the Dunlossit Estate and consists of rough single-track roads. A steep track access point, with existing Aid to Navigation (AToN cable warning diamond, and termination pole can also be seen in the distance.

5.2 Proposed installation method

An indicative installation methodology is outlined below. The final methodology will be engineered following the results of the route engineering survey operations and on completion of the OBS. The methodology is intended to give an overview of the options available to the cable installation contractor and has been used to inform the environmental assessment provided in MEA, so that the worst-case impact scenarios of the installation have been considered.

Vessels and equipment proposed to be utilised during the installation are summarised in Section 5.5.

5.2.1 Pre-lay survey and boulder-picking

Prior to lay operations commencing, a pre-lay survey will be conducted, this will be undertaken using a work class ROV. The objective of the survey is to:

- Identify and investigate possible debris; and
- Identify any obstructions on the proposed route including the presence of boulders which may impede the safe installation of the cable.

Boulders may be removed using a "grab" tool deployed from a support vessel with suitable crane, as shown below in Figure 5-12. This will be dependent on the results of the boulder removal assessment which will be done during the pre-lay survey.

If debris or an obstruction cannot be removed from the planned route, the offshore surveyors will micro-route around the debris/obstruction in consultation with the onboard Client Representative (CR). Any micro-routing will always remain within the licenced installation corridor.

Debris identified and removed along the route will be disposed of as outlined in the offshore Construction Environmental Management Plan (CEMP) (Document Reference: P2635_R6213).

5.2.1.1 Boulder removing 'Orange Peel Grab' tool

Although the cable route will be engineered to avoid as many boulders as practical, a hydraulic operated grab may be required to remove any boulders that may impede the safe installation of the cable. This system will be operated from the surface and deployed using a boulder removal vessel such as the DSS Olympic Delta (Figure 5-12) support vessel work crane. An ROV will assist in the positioning of this tool.

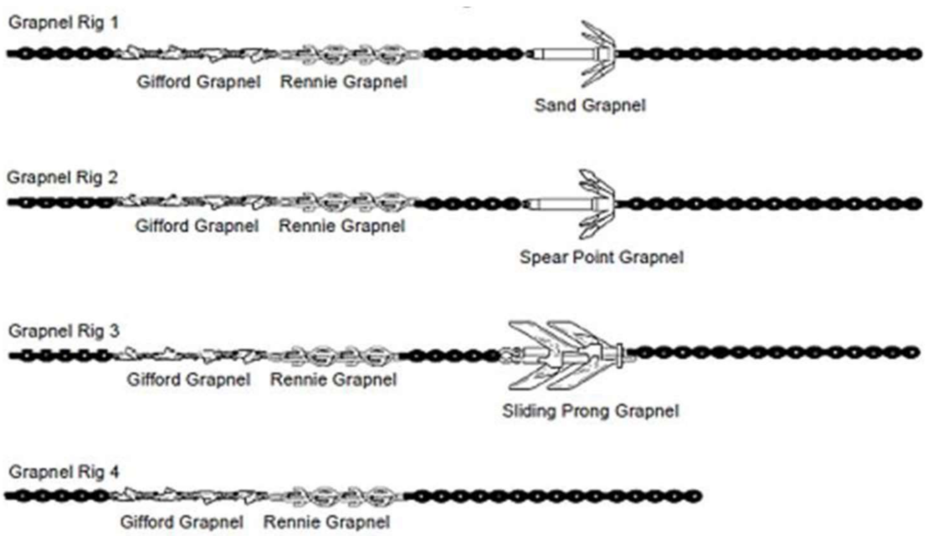
Figure 5-12 DSS Olympic Delta, boulder removal, crossing and stabilisation operations vessel

Source: SSEN, 2023

5.2.1.2 Pre-lay grapnel run (PLGR)

Any obstructions or debris which cannot be avoided will be removed, if possible. A PLGR will be undertaken to remove debris from the proposed installation corridor. A PLGR may be required to remove debris for example cables, chains, wires, ropes, and fishing gear. Therefore, it is expected that this activity will be completed prior to the cable installation activities to ensure that the installation corridor remains free of debris prior to installation. A typical grapnel train is shown below in Figure 5-13 and Figure 5-14. Multiple PLGR's both end to end or perpendicular to the route may be required within the licenced installation corridor to remove debris. Where OOS cables have been cleared the cut ends will be secured with clump weights if required to prevent cable movement.

Figure 5-13 Grapnel train (typical example)



Source: SSEN 2022

Figure 5-14 Example of grapnel and chain at stern toller of vessel

Source: SSEN 2022

5.2.2 Installation monitoring

During the installation of the cable, a survey will be undertaken to monitor the installation process. Touch down monitoring of the cable will be conducted to confirm the position of the cable, this will be done as the cable is laid, using an ROV or a cable fish. The ROV will be deployed from the cable lay vessel (CLV) or a separate support vessel (Image 1 in Figure 3-1) that will be present during the installation. An example of the ROV and survey equipment that will be used during the installation is presented in Figure 3-1 (Image 2). All equipment used will be within the requirements set out within the European Protected Species (EPS) and Basking Shark (BS) Licences provided for the survey works.

5.2.3 Vessels

Table 5-2 below provides an overview of the types of vessels that will be installed during the installation of the cable, these vary from Cable Lay Vessels, Dive Support Vessels and other support vessels. These specific vessels or vessels with similar specifications will be used in the installation of the replacement cable.

Table 5-2 Installation Vessels

Name of Vessel	Type of Vessel	Vessel Specification	Positioning System/ Spud diameter	Working limits
MV Elektron	Cable Lay Vessel (CLV)	GT – **3,438** DL – **87m** DB – **18m**	DP 2	<10m
Olympic Delta	Cable Lay Vessel (CLV) / Boulder Removal Vessel	GT – **5,395** DL – **92.55m** DB – **19m**	DP 2	<10m
Forth Jouster	Dive Support Vessel (DSV)	GT – **167** DL – **26m** DB – **11.5m**	610 mm with spiked tip	<13m
Forth Warrior	Dive Support Vessel (DSV)	GT – **296** DL – **27m** DB – **12m**	610 mm with spiked tip	<13m
Forth Guardsman	Dive Support Vessel (DSV)	GT – 654 DL – 50m DB – 14.6m	GPS system diameter; 2 x 914mm long; 18m	2.1m
Carly	Other Support Vessel	GT – **185** DL – **30m** DB – **8.3m**	N/A	1.5m
Celtic Guardian	Other Support Vessel	GT – **9.5** DL – **13.9m** DB – **4.3m**	N/A	0.7m

GT- Gross tonnage – DL – Dimension Length – DB – Dimension Beam

5.3 Landfall Preparation

The landfall areas will be prepared with the following tasks undertaken:

- Site setup, including fencing, signage, welfare units etc;
- Site walk-over;
- Nearshore visual survey;
- Excavation works along landfall cable route (above MHWS at TJP to MLWS); and

Cable pull-in preparation, including cable rollers, quadrants winches etc.

5.3.1 Access to site

Personnel can access the Jura site via the A846, which is a single lane road, with regular passing places. There is no parking at the roadside close to site, other than laybys. The site is approximately a 1km walk from the road, down a steep hill, access is difficult because of soft terrain, ditches, streams, and shin high vegetation. It is likely that a track would need to be installed.

Access to Islay from the mainland is via Kennacraig, using the Ferry. Access to site is entirely though the Inver Estate, which consists of a rough single-track road. There are some steep slopes and tight corners with loose rock (a 4x4 vehicle may be necessary). A number of gates are present along the route that would need to be effectively managed. There is an approximate 1.2km walk along a track which would be unsuitable for cars, before a downhill decent to the beach were the landing point will be.

A landing craft vessel (Forth Guardsman or similar) may be used to access the landfall sites from the Sound of Islay, if seabed terrain permits. The vessel will be used to mobilise and demobilise all equipment that will be used during the installation works.

5.3.2 Site compound

For the onshore engineering works a base will be established which will also act as a local site management office for the works. It shall comprise of, but is not limited to, the following:

- Suitable office accommodation, including space for: site briefing/training, electrical supply internet and telephone connectivity (where applicable and signal is available);
- Lay-down areas designed to take the biggest loads likely to be delivered to site;
- Secure storage areas for all required materials, with segregation of material in line with Safety Data Sheets (SDS) requirements
- Compound lighting where work is required to be undertaken in low light levels, directional lighting will be used on shore end, to minimise light disturbance;
- An area designated for waste and waste recycling skips, with clear signs to indicate the waste segregation requirements of each container or skip; and
- All onshore operations and facilities will be covered by an onshore Construction Environmental Management Plan (CEMP).

The site shall have a traffic management plan to maintain safety of traffic entering and exiting the compound. It should be noted that traffic at the local site compounds shall be light and minimal throughout, with the heaviest traffic during set up and tear down of the compound.

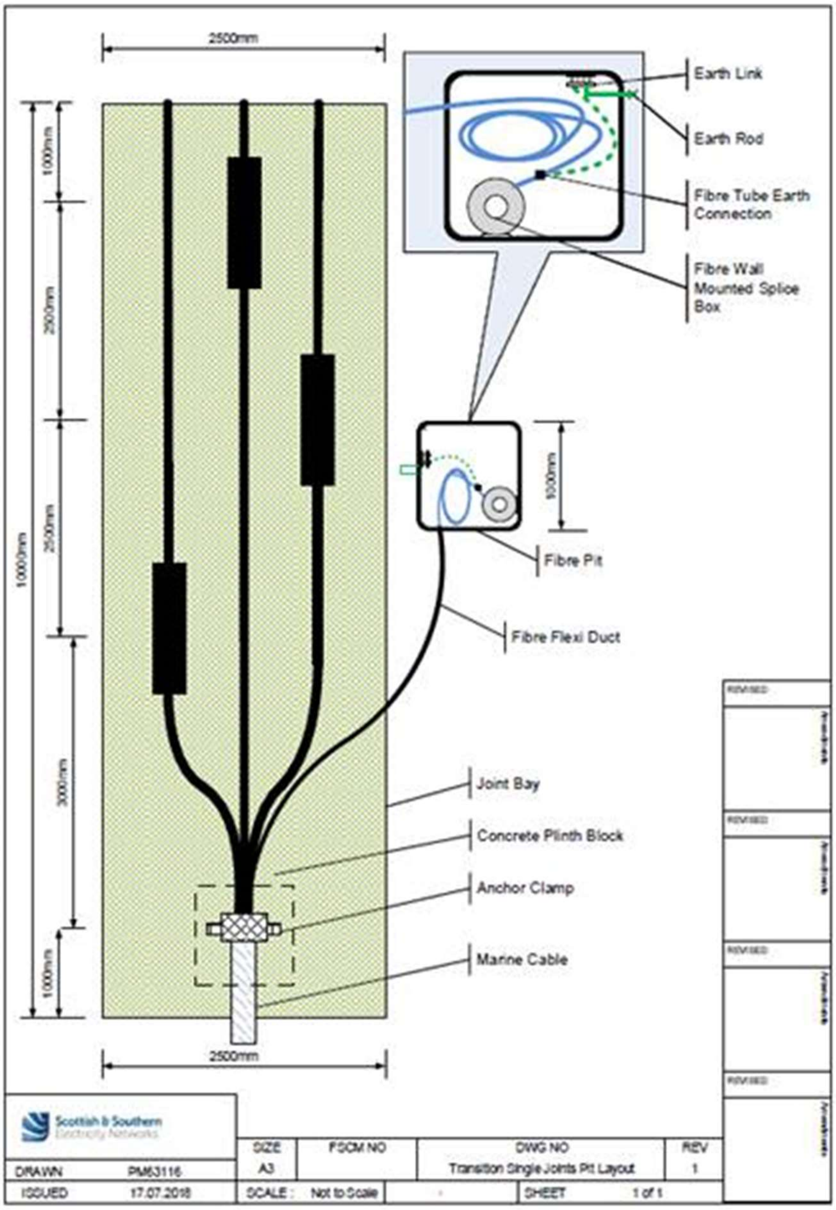
The site compound will be secured from the public by means of Heras fencing where applicable and or pedestrian walkways, all relevant site signage and warning signs will be posted where necessary to ensure site safety and public safety.

All responsible methods will be employed to mitigate environmental damage and in particular spill kits (120L bins) and machine nappy pads to catch leaks and drips on site. The compound shall comply with the environmental requirements for all activities impacting protected or sensitive habitat or species.

5.3.3 Transition joint pit (TJP)

The TJP will be the location where the subsea cable is split out into its individual cores and terminated to a land cable. The TJP at each landfall are located above MHWS and will utilise a sea earth. As the Marine Licence Application Corridor only covers up MHWS details on the TJP are only included in this report to provide further information on the Project. Figure 5-15 outlines the TJP plan for both landfalls on Jura and Islay.

Figure 5-15 SSEN TJP plan



Source: SSEN, 2018

5.4 Intertidal cable installation

5.4.1 Open cut trench

At both landfalls, the cable will be buried within the intertidal areas using an Open Cut Trench (OCT) (Figure 5-16) method, from the MHWS to MLWS. Each landfall will have two trenches excavated, one trench will be for the replacement cable and armour earth, while the other trench is for a fibre optic cable earth.

This will be undertaken using the following equipment:

- 1 x 20tn and 1 x 8tn excavators (complete with rock pecker attachment, for areas of bedrock),

The trenches will be 1m in width, and the target depth of the trench will be to the top of the cable at approximately 800mm below ground level. However, this is subject to ground conditions at the ground conditions such as the soil stability and the nature of subsurface sediments. This will be better understood on completion of the intertidal surveys. Excavators complete with rock pecker attachment, will be utilised to reach the depths required to bury the cable in the intertidal zones of each landfall. It is also possible that a split pipe may be used on sections of the trench route where burial depth cannot be viably done.

Each landfall's OCT will require a 20m corridor width to conduct the works, which will be sufficient space to operate the excavator and temporarily store the excavated material. The length of the intertidal excavation sites will be 40m and 30m at Jura and Islay, respectively. Once the trenching activities are completed, the excavated material will be backfilled into the trench, returning the intertidal area to pre-works condition.

Figure 5-16 Example OCT

Source: SSEN, 2022

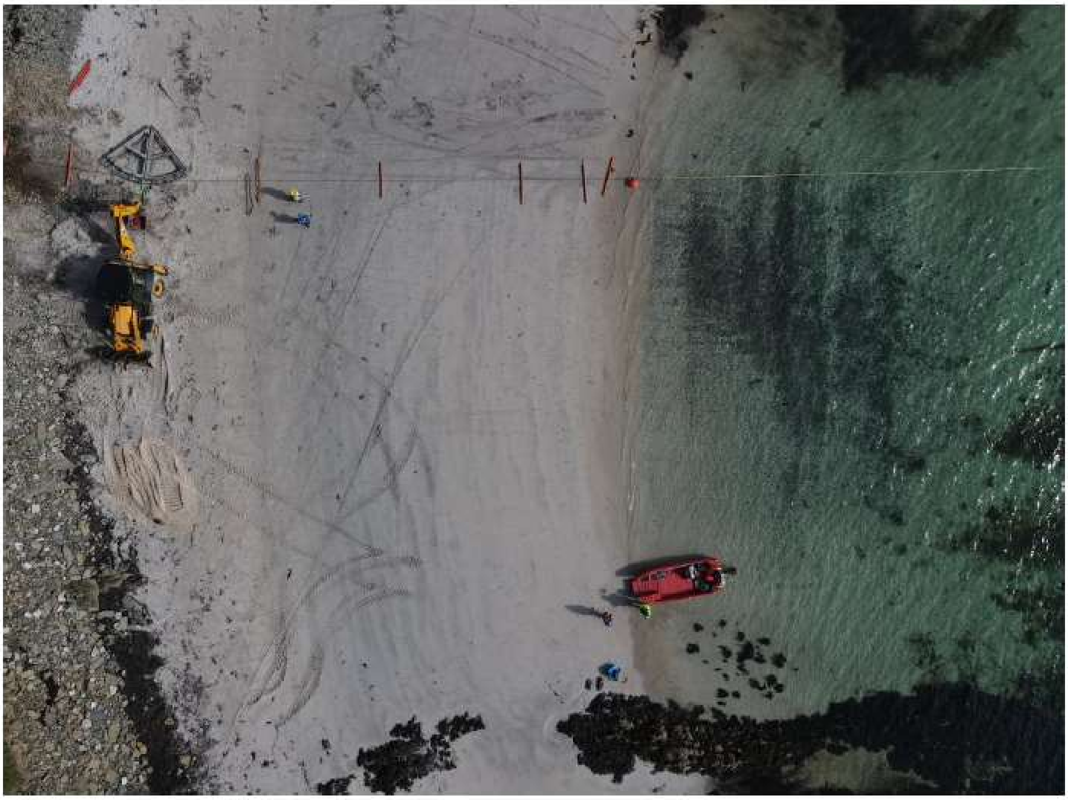
5.4.2 Intertidal cable pull in

Cables will be pulled onto land using two winches, this will be on a rising tide along with a combination of rollers (Figure 5-17) and quadrants (Figure 5-18). This equipment will allow the cable to be safely pulled ashore without any damage. Rollers will be used to support the flow of the cable as it's pulled in using the winches and the quadrants are used to ensure that the cable is pulled into the intertidal area in the correct alignment. Anchor plates will hold the rollers and quadrants in place while the process of the pull-in takes place, these anchor plates will be buried at first and then removed once the cable has been fully pulled ashore.

Figure 5-17 Example images of rollers

Source: SSEN, 2022

Figure 5-18 Example of rollers and quadrants



Source: SSEN, 2022

5.5 Marine cable installation

The following installation method is based on that utilised during previous 100% surface laid cable installations that SHEPD have undertaken. This has been used as the basis for the present environmental appraisal.

5.5.1 First end pull in

The CLV will position at the first end pull-in site (Jura), generally stationed at the 10m water depth (WD) contour (this is dependent on the vessel's draft). Deck handling equipment will be used to direct the cable to the over-boarding chute. An example CLV which will be used during the installation is displayed in Figure 5-19 below.

Figure 5-19 MV Elektron CLV

Source: Vessel finder, 2023

A messenger line will be taken from the CLV via small support craft to the shore. This will be connected to the shore winch line at MLWS. The small support craft will then pull back the mooring line and pull-in winch wire from the shore to the CLV where it will be connected to the cable end. The shore end winch will commence pulling in the cable with buoyancy units attached onto the cable as it leaves the vessel to 'float' the cable ashore. The cable will be secured at the TJP, surface swimmers will gradually remove the buoyancy units completing the first end pull-in operations.

5.5.2 Cable lay operations

Following successful completion of the first end pull in the CLV will commence laying the cable on the seabed from the First end to the Second end; a smaller support vessel may be used in the shallower shore locations. DSV, nearshore, and guard vessel(s) may also be required during cable lay operations.

The cable will be surface laid from MLWS to MLWS as the majority of the installation corridor does not have good burial potential.

During cable lay operations, the vessel crew will monitor the lay to ensure the cable is laid within the consented installation corridor and that the mechanical parameters of the cable are adhered to.

During these operations, the vessel structure may be outside the licenced corridor however all deposits will be installed within the allocated boundary. Vessel movements will be notified by notice to mariners issued to inform other sea users for safety as outlined in the FLMAP.

5.5.3 Second end pull in

Once the cable is laid across the seabed, the vessel will either manoeuvre off the RPL and float the cable off the vessel or remain in position on the RPL and pay out cable into a floated omega bight. This is to allow the cable to be cut at the required length prior to pulling the cable into the second end landing point at Islay.

The bight may be outside of the cable installation corridor whilst in the water column at certain points during deployment, however final installed position will be within the boundary of the licenced area.

The supporting FLMAP and MEA references the notifications issued to sea users to inform which activities are taking place. Navigational broadcasts will be issued via Navigational telex (NAVTEX) and Notices to Mariners (NTMs) distributed by the Kingfisher fortnightly bulletin and on social media.

As per the First end, buoyancy units will be attached to the cable as it is being paid out to float the cable ashore. An example of a Second end bight is shown in Figure 5-23.

Once the cable is floated out into a bight, a messenger wire will be sent ashore from the CLV on a support craft. The messenger wire will be connected to the to the shore winch which will then be pulled back to the CLV and connected to the cable end. The cable will then be pulled into the Second end landing point. Surface swimmers will then gradually remove the buoyancy units allowing the cable to come to rest on the sea floor. The shore winch will pull in any slack to complete installation operations.

5.6 Cable protection methods

This section outlines the envelope of all potential marine cable stabilisation and protection methods for which consent is being sought.

Upon completion of OBS Assessment for the Jura to Islay route it will be possible to better identify the quantities of cable protection and stabilisation to be employed along the route.

Split pipes and Sea Earths will be utilised to provide protection for the replacement cable. Worst case scenario quantities, dimensions and weight for each protection method is provided in Table 4-1 in Section 4, and is the basis of the assessment made in the MEA.

5.6.1 Split pipe (articulated pipe)

The cable protection strategy includes the installation of cast-iron articulated pipe. Generally, this is installed following the cable pull-in operations by divers or from the CLV during cable lay, or by a combination of both methods. This protects and stabilises the cable in the nearshore and intertidal section of the cable route.

See the cable protection and stabilisation plan detailed in Table 4-1 for the length of anticipated articulated pipe installation.

5.6.2 Sea Earths

Sea Earths will be installed to provide protection from surges and lightning strikes to the electrical circuit. It is expected that two earthing cables will be required at each shore end using stainless steel wire. One cable will earth the armour of the HVAC cable system, while the other provides an earth for the fibre optic armour (integral to the HVAC cable system).

At the intertidal zone, the earth wire will be installed in a separate trench with a minimum separation of 10m. The working corridor will be 20m either side of each trench (10m either side of the cable). This will still be inside the consented corridor as defined by SHEPD. The excavator will be utilised, so the trench will be excavated using the same method employed for the subsea cable, as detailed in Section 5.4.1. Below MLWS the sea earths will be surface laid, concrete clump weights may be used to anchor the sea earths at intervals/at their termination subsea.

5.6.3 Other protection methods

5.6.3.1 Concrete mattresses

If shallow water concrete mattress installation is required when the replacement cable crosses the existing cable or the out of service cables, a Multicat type vessel will carry out the installation in shallow water. During the installation in shallow water, the Multicat will hold position using spud legs, to position the mattresses along the route of the existing cable. Alternatively, concrete mattresses may be installed by the CLV or similar support vessel.

5.6.3.2 Rock bags

The cable protection strategy may include the installation of rock bags onto the cable to provide stability. The rock bags will be stored on the vessel and lifted into position using the vessel's crane. The vessel's ROV monitors the installation and detaches the crane wire from the rock bag once in position.

Where practicable, the rock bags will be filled with stone local to the installation site. The rock bags may be installed as soon as the cable is laid by a separate vessel to the cable lay vessel. Simultaneous Operations (SIMOPS) between the two vessels will be managed in the planning phase as well as the offshore phase via implementation of a SIMOPS plan. Each vessel will be named in the NtM as required in the supporting FLMAP.

5.6.3.3 Uraduct

Uraduct is a synthetic cable protection system designed to safeguard the replacement cable when it intersects with in and out-of-service cables. Fitted to the replacement cable typically 50m either side of a crossing, Uraduct offers a solution that can be used as an alternative to traditional concrete mattresses or in conjunction with them. This technology provides an effective means to protect and secure cables in various industrial and infrastructure applications.

5.7 Post installation survey

Once all installation activities have been completed, a post installation survey of the installed infrastructure will be conducted to confirm its as-built position and to ensure that the design requirements have been met. This will record the as-installed position of the cable and the deposits utilised to stabilise and or protect the cable. The landfall sites will also be reinstated as agreed with landowners. The replacement cable will subsequently be electrically jointed to the land-based HV infrastructure. The routing and installation of the land HV infrastructure is not covered as part of this Project Description which supports the marine licence application. The as-built survey will document the installed position of the cable from TJP to TJP with events listed and positions given (i.e. rock bags, mattresses, articulated pipe etc.).

The post installation survey will utilise a similar survey method to that described above in section 3.2. Details of the as-built locations of the cable and associated protection measures will be provided to the UK Hydrographic Office and the Kingfisher Information Service for inclusion on Admiralty Charts, and Offshore Renewable and Cable Awareness Charts respectively.

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