APPENDIX V1-4.1: ALTERNATIVE TECHNOLOGY OPTIONS AND DESIGN SOLUTIONS

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1.1 Introduction

1.1.1 This Appendix summarises the findings of a review into alternative technology options and design solutions for the Skye Reinforcement Project that has been undertaken as part of the route and alignment selection stage of the project.

1.1.2 The review focussed on the feasibility of cabling options (both subsea and land), as well as the potential to use alternative steel structures (NeSTS) in targeted areas. The review enabled a fuller understanding of the technical viability, environmental impact and cost of such options, in comparison with a steel lattice OHL.

1.1.3 The need for the project and the work undertaken by SSEN Transmission to assess the strategic electricity transmission infrastructure requirements is set out in **Volume 1: Chapter 2 – Project Need and Strategy.**

1.2 NeSTS

1.2.1 New Suite of Transmission Structures (NeSTS) are a series of steel pole structures that have been developed as part of a Network Innovation Competition (NIC) innovation project to design an OHL structure that aims to lower the environmental impact of OHLs. The design of these structures has been developed in close consultation with key statutory bodies, utilising visualisations and 3d modelling to seek comment on their appearance and potential utilisation on the transmission network.

1.2.2 The technology comprises of a series of pole sections making up the main body of the structure, with the cross arms that hold the conductor and associated fittings/components, attached to the top section. The pole is made up from sheet steel folded on a press plate with 12 sides to a pole, each section is lifted into position with a crane and positioned over the one below with an overlap on the taper to create a slip joint. The joint is pulled together with hydraulic pulling rams to a predetermined stress, using gravity and friction to keep each joint in place. Typically, a pole suitable for the Skye circuit would have 3 sections. **Plate 1.1** provides an example of a NeSTS pole.

Plate 1.1: Example of NeSTS pole with larger 400m+ spans

1.2.3 The construction toolset for NeSTS is similar to that of lattice towers, and requirements for access tracks, foundation types and environmental constraints are weighed up to develop the optimum alignment through the design phase.

1.2.4 The NeSTS structures have been designed to enable larger spans, and therefore to enable OHLs to comprise fewer structures in response to stakeholder request.

1.2.5 The use of NeSTS has been considered on this project during the alignment selection stage in particular areas to navigate challenging terrain, or to offer an alternative OHL solution that could potentially result in greater span lengths and fewer structures. Whilst NeSTS can offer these advantages, it was considered that the more solid appearance of the NeSTS towers would have similar, if not more prominence than the steel lattice towers in this landscape. The transition between structure types if NeSTS were proposed in isolated areas could also result in a visually confusing wirescape. Furthermore, although the taller towers allow greater spans, it is not always possible to take advantage of this due to topography. Therefore, the use of NeSTS was not proposed as the preferred OHL technology solution for the Skye Reinforcement Project.

1.2.6 Specifically, within Section 2 of the project, the use of NeSTS was considered between Sligachan and Broadford as an alternative design solution to the steel lattice OHL. The installation of NeSTS poles within this area would be a viable alternative in technical terms to a steel lattice OHL, and the longer span lengths that are possible with the NeSTS poles would enable more direct alignment options around the heads of Lochs Ainort and Sligachan to be explored.

1.2.7 Whilst the use of taller towers with a wider span would theoretically lead to fewer towers within the Cuillin Hills National Scenic Area (NSA) and surrounding areas, the more solid appearance of the NeSTS towers would have similar, if not more prominence than the steel lattice towers in the landscape. Taller towers of either structure type would continue to form a barrier effect around the edge of the NSA and in views from the A87 and settlement areas featuring the mountains and coast. In addition, the taller towers would have greater potential to skyline in views and to reduce the apparent scale and grandeur of the landscape.

1.2.8 The NeSTS option was therefore not progressed as an alternative design solution within Section 2 of the project as it would not mitigate likely significant landscape and visual effects on the NSA and other receptors.

1.3 Underground Cables

1.3.1 Underground cable technology has been used within SSEN Transmission and the wider UK transmission industry for many years. Key considerations in relation to its installation relate to topography, ground conditions, access and other environmental considerations (e.g. watercourse crossings, sensitive habitats etc.), as well as the requirement for reactive compensation at connected substations.

1.3.2 An underground cable solution for this project would comprise of a double circuit, with a cable rating required to match the corresponding OHL at 348 Mega Volt Amps (MVA). The cables would be terminated at a Cable Sealing End (CSE) compound, which would allow for transition between underground cable to OHL (an example is shown in **Plate 1.2** below). A permanent access track would be required at each CSE compound.

1.3.3 The overall cable construction corridor would need to be approximately 37 m wide to accommodate excavation and cable installation equipment and store excavated materials during construction for reinstatement once the installation process is complete. A haul road would be constructed along the length of the cable section during the construction phase, with the circuits installed on either side. Similarly, access points and tracks from existing public roads to the proposed haul road would likely be required.

Plate 1.2: Example of a Cable Sealing End Compound

1.3.4 To facilitate a more efficient installation cables would likely be installed via ducts. These plastic ducts would be installed prior to the cable pull job to minimise open ground works / excavations. The high voltage cable would then be pulled into place at each joint bay location.

1.3.5 Other technical and economic factors to consider include:

- Fault finding, which is typically more complex, time consuming and costly on underground cable systems in comparison to OHLs. General visual inspection and maintenance is more challenging as accessibility is naturally restricted;
- Power losses, which can be a key consideration and limiting factor in terms of the maximum length of an underground cable solution that could be installed, requiring reactive compensation measures (comprising additional works at linked substation sites, consisting of a similar installation to a new grid transformer and associated bay); and
- Due to higher installation costs compared to an OHL, and the requirement for reactive compensation measures at substation sites on the transmission network, an underground cable solution would result in a considerable increase in the cost of the project as a whole.

1.3.6 The viability of an underground cable as an alternative design solution was considered during the route and alignment selection stage in Sections 2, 3 and 6 of the project. Through consultation[1], other areas were highlighted by stakeholders for consideration of undergrounding. These areas are discussed further below.

Section 2

1.3.7 Section 2 is characterised by the mountains of the Black and Red Cuillin ranges which rise steeply from the shore providing a prominent landscape and visual focus, and the long fjord-like sea-lochs of Loch Sligachan and Loch Ainort which cut deeply inshore to the feet of the mountains. This is a sensitive and dramatic

[1] Skye Reinforcement Project: Report on Consultation (March 2022), produced by SSEN Transmission

landscape and the accessibility provided by the A87 trunk road, which winds around the bases of the mountains and around the heads of the lochs, results in this area being highly popular with tourists and visitors.

1.3.8 The majority of the route follows the A87 and skirts the edge of the Cuillin Hills NSA and Cuillins Wild Land Area (WLA). In terms of an overhead solution, although the steel lattice towers would replace existing wood poles, the greater prominence of these structures in relation to the sensitivity of the landscape is considered likely to result in significant landscape effects. It is considered that structures may be distracting in valued mountain views and may lead to a barrier effect across the base of the mountains, particularly when seen from the A87.

1.3.9 New OHL structures would be potentially visible to the rear of properties at Sconser, Luib and Strollamus and would be potentially prominent and distracting in views from parking laybys and tourist sites along the A87 at Loch Sligachan and Loch Ainort, from Peinachorrain and from the Raasay Ferry on the approach to Sconser. There is the potential for some of these visual effects to be significant.

1.3.10 To inform the alignment selection process, a landscape and visual appraisal of the Baseline Alignment[2] (OHL) was carried out to determine the likely significant effects on landscape and visual receptors within Section 2. This appraisal[3] concluded that significant effects to the landscape and visual resource would be likely, including likely significant effects to the Cuillin Hills NSA, visual receptors at settlement and tourist areas throughout Section 2 and a number of road and recreational routes, including the popular A87 trunk road. Further significant effects to Wild Land Area 23: Cuillin, as well as other residential and recreational visual receptors within the study area are also considered possible.

1.3.11 Given these sensitivities and likelihood for significant effect, an underground cable solution was considered within this section.

1.3.12 The installation of an underground cable within Section 2 would present a number of technical and environmental challenges, a summary of which are noted below:

- Potential effects on the surface water and hydrogeological regime, and subsequent effects on Groundwater Dependent Terrestrial Ecosystems (GWDTE);
- Effects on soils and peat. Ground conditions are likely to be variable throughout Section 2, with rock close to the surface in some areas, and deeper areas of peat in others. Such conditions would need to be established prior to finalising a cable route, and areas of deeper peat avoided as far as practicable;
- A number of watercourse crossings would be required, including at the heads of Loch Sligachan and Loch Ainort. It is likely these would be achieved by Horizontal Directional Drill (HDD);
- During construction the establishment of a working corridor would result in disruption to predominantly wet heath and some bog habitats, which are found throughout Section 2;
- Potential for landscape and visual effects during the construction phase, albeit these should be short term, subject to appropriate and carefully planned reinstatement; and
- In areas where the cable route would be within the vicinity of the A87, or require crossing the road (or other minor roads), there would likely be a requirement for road closures and traffic management systems to be put in place.

1.3.13 It was recognised by SSEN Transmission that the mitigation of these effects during construction would be key to the success of an underground cable route within part of Section 2 of the Skye Reinforcement Project. It is

[2] The Baseline Alignment is the alignment identified by the OHL Contractor during the alignment selection stage of the project on the basis of it being the most technically feasible and economically viable alignment and design solution, giving due consideration to a range of technical and cost criteria over the construction and operation phases of a new OHL.

[3] Included as Appendix 5 within Skye Reinforcement Project: Consultation Document: Alignment Selection (September 2021), produced by SSEN Transmission

anticipated that standard and best practice mitigation measures in relation to the construction effects of an underground cable would be covered in a project specific Construction Environment Management Plan (CEMP) and Construction Method Statements, that would be developed in accordance with industry best practice guidance, including Pollution Prevention Guidance (PPGs). A Peat Management Plan and Site Restoration Plan would also be required to set out procedures for stripping, handling, storage and re-use of soil and peat. Drainage design of the temporary haul road would also require careful consideration to preserve the natural hydrological regime as much as possible. This would be set out in the Construction Method Statements. Where interaction with the local road network occurs, a Traffic Management Plan would be required.

1.3.14 Despite the number of constraints and challenges associated with the installation of an underground cable, as well as additional cost, an underground cable solution would provide the opportunity to mitigate the long term likely significant landscape and visual effects of an OHL solution through parts of Section 2, in particular the likely significant effects on the Cuillins NSA and on other landscape and visual receptors within the vicinity.

1.3.15 As such, it is proposed to underground approximately 15 km of the OHL from the north of Sligachan to Luib to mitigate likely significant landscape and visual effects. As a result, large reactive compensatory equipment is needed at both Broadford and Edinbane substations to rebalance the system issues created by the cable in order to allow operation of the transmission network in compliance with the required codes and standards. This has meant that the size of these substation sites has had to increase substantially to accommodate the footprints of the necessary additional equipment. Any further extension to the proposed cable lengths would require further system studies to assess the feasibility of the system to remain compliant and operate properly under this scenario, and if feasible would lead to further increases in the size of the substation sites to accommodate the greater footprint of larger and additional equipment needed to run the network accordingly, as well as substantially increasing the cost of delivering the project.

Section 3

1.3.16 The viability of an underground cable as an alternative design solution within part of Section 3 of the Skye Reinforcement Project was focussed on the consideration of mitigating likely significant landscape and visual effects of the Alternative Option within and from Glen Arroch and Kylerhea settlement (referred to as Route Option 3B during the route and alignment selection stage).

1.3.17 The use of underground cable was not deemed to be a practicable or appropriate technology choice for the Proposed Alignment (referred to as 3A during the route and alignment selection stage) within the Kinloch and Kyleakin Hills Special area of Conservation (SAC) given the steep terrain (in places) and sensitive habitats present along this route. The installation of an underground cable here would almost certainly result in likely significant effects on the SAC and its qualifying features due to the extent of the construction corridor required.

1.3.18 The installation of an underground cable through Glen Arroch and Kylerhea (the Alternative Option (3B)) would present a number of technical and environmental challenges, a summary of which are noted below:

- Likely significant effects on the Kinloch and Kyleakin Hills SAC due to disruption to peatland habitats and qualifying features of the SAC given a working corridor of approximately 30 – 40 m (including haul road). Such effects are likely to be much greater for an underground cable in comparison to a steel lattice OHL given a much larger working corridor and habitat loss, increasing the potential for pollution events and watercourse crossings within the SAC, as well as potential hydrological and hydrogeological effects;
- A number of watercourse crossings would likely be required given proximity to the Abhaimm Lusa, Allt Mor and Kylerhea River watercourses;
- Effects on soils and peat. Ground conditions are likely to be variable throughout Section 3, with rock close to the surface in some areas, and deeper areas of peat in others. Such conditions would need to be established prior to finalising a cable route, and areas of deeper peat avoided as far as practicable;

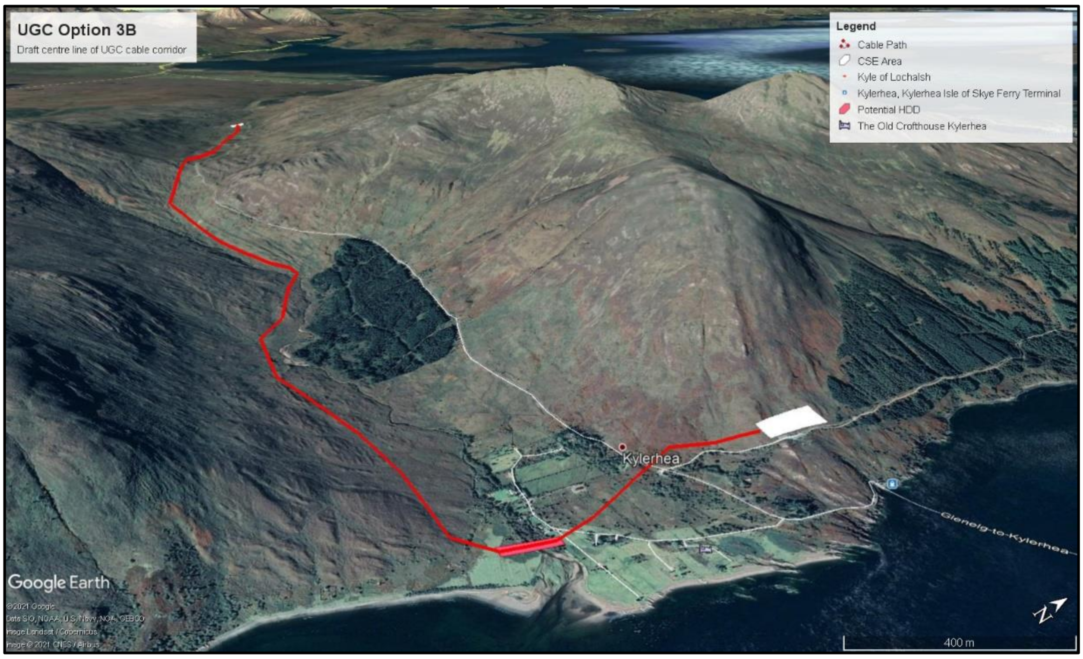
- Potential for landscape and visual effects during the construction phase, albeit these should be short term, subject to appropriate and carefully planned reinstatement;
- Requirement for reactive compensation at Broadford and Fort Augustus Substations, resulting in additional works being required at these substations to account for power losses inherent in underground cables; and
- Due to higher installation costs compared to an OHL, and the requirement for reactive compensation measures at substation sites on the transmission network, an underground cable solution would result in a considerable increase in the cost of the project as a whole.

1.3.19 Mitigation measures for environmental effects of underground cabling in Section 2 (see 1.3.13) would also be relevant here.

1.3.20 Engineering studies were undertaken into the technical viability and extent of underground cable options within the Alternative Option (Route Option 3B). These studies concluded that the viability of an underground cable through part of Route Option 3B would be limited to an area from approximately Bealach Udal to Kylerhea (RSPB hide) (approximately 5 km in length), as indicatively illustrated on **Plate 1.3**. Opportunities for undergrounding beyond these areas were restricted by topography and ground conditions, together with technical limitations on the viable length of cable route possible.

1.3.21 Whilst offering the potential to mitigate likely long term significant landscape and visual effects, an underground cable solution as part of the design solution within the Alternative Option (Route Option 3B) would be a considerable challenge given the steepness of slope and ground conditions. Likely significant landscape and visual effects in the short term could occur given the width of the construction corridor and requirements for a haul road. There would also be the requirement for CSE compounds at either end of the cable route, prior to transitioning back to OHL, which would result in likely significant landscape and visual effects. The underground cable would also pass through part of the SAC, with the potential to adversely affect site integrity.

Plate 1.3: Indicative Underground Cable Route within the Alternative Option (Route Option 3B)



1.3.22 Due to the technical limitations and challenges of installing an underground cable route within this part of the Alternative Option (Route Option 3B), coupled with the likely significant effects on the SAC, and landscape and visual receptors both in the short term (construction) and long term (likely significant effects of the sealing end compound and OHL infrastructure beyond the underground cable), it was concluded that underground cabling should not form part of a viable design solution within the Alternative Option (Route Option 3B). Therefore, steel lattice OHL is the only viable design solution within the Alternative Option (Route Option 3B).

Section 6

1.3.23 Within Section 6, the use of underground cable has been considered to facilitate rationalisation of the existing OHL infrastructure within the area, and in light of likely future connection requirements.

1.3.24 As such, SSEN Transmission deemed that an underground cable solution is required to meet these aims, and it is proposed to underground the OHL for the entirety of Section 6, approximately 9 km.

Other Areas

Through consultation[4], other areas were highlighted by stakeholders for consideration of undergrounding. These areas included:

- Section 1, to mitigate potential significant effects on ornithology and landscape and visual receptors;
- Section 2, to extend the length of undergrounding to Broadford Substation to further mitigate potential significant landscape and visual effects; and
- Section 5, within the vicinity of Loch Garry and Loch Loyne, to mitigate potential for significant effects on the West Inverness-shire Lochs SPA and its qualifying features.

1.3.25 In response, SSEN Transmission confirmed that the routeing and alignment selection stage of the project has sought to develop an alignment and design solution that seeks to minimise the potential for significant effects as far as practicable. Given the commitment to underground approximately 24 km of the 160 km OHL (within Sections 2 and 6), the project would not seek to extend the areas of proposed undergrounding any further.

[4] Skye Reinforcement Project: Report on Consultation (March 2022), produced by SSEN Transmission

SSEN Transmission explained that installing large sections of underground cable on the network not only comes at a significant additional cost, 2-3 times the cost of overhead solutions, but also creates network performance issues that need to be addressed using specific technical and engineering solutions. Due to the lengths of cable proposed on the Skye Reinforcement Project, large reactive compensatory equipment is needed at both Broadford and Edinbane substations to rebalance the system issues created by the cable in order to allow operation of the transmission network (see 1.3.15 for further details).

1.4 Subsea Cables

1.4.1 A desktop study of potential subsea cable options and indicative landfall locations has been undertaken between Portree and Broadford on the Isle of Skye, covering much of Section 2 of the Skye Reinforcement Project. Consideration was also given to potential subsea cable options between Broadford and Kyle Rhea (i.e. Section 3 of the Skye Reinforcement Project).

1.4.2 The desktop study included a review of a wide variety of data, covering the physical environment, environmental and ecological factors, and other sea users. Following this, identification and charting of potential subsea cable routes and constraints were mapped and assessed, with potential for mitigation or avoidance of particular constraints considered.

1.4.3 **Plate 1.4** shows indicative landfall locations and cable routes covering both Section 2 and 3.

1.4.4 A subsea cable solution for this project would comprise of a double circuit, with a cable rating required to match the corresponding OHL at 348MVA. This would either involve four 132 kV cables, requiring CSE compounds (see **Plate 1.2**) at either landing point location, or two 220 kV cables which, due to the rating change required, would mean the electrical equipment required to step the voltage up and down at the transition point between OHL and subsea cables would be similar in scale to a 132 kV transmission substation site.

1.4.5 There are a few key technical parameters to consider when assessing the suitability of subsea cable routes. The first of these is water depth. Due to the repair criteria a separation distance must be a minimum of 1.5 x water depth, so the deeper the cable is installed the greater the separation requirements between different circuits. Second is the thermal rating of cable circuits in shallow water, which could affect the cable cross section required. Third is the interface with other sea uses, particularly fishermen, as installing subsea cable in areas of higher activity increases the risk of anchor strike in shipping lanes. Lastly are the seabed conditions, which will determine the required burial depth on the sea floor and method of cable protection if required burial depths cannot be met via typical methods.

1.4.6 Submarine cables are generally installed by a cable laying ship with the aid of robots used to control cable laying on the sea bed. Due to their cost to install and strategic value, high voltage electrical cables are generally buried on the sea floor to protect them from general wear and risk of damage. There are various techniques used to undertake this, with popular methods being hydro jet burial or ploughing. **Plate 1.5** shows a diagram of the process using a cable plough.

Plate 1.4 – Indicative Landfall Locations / Subsea Cable Routes

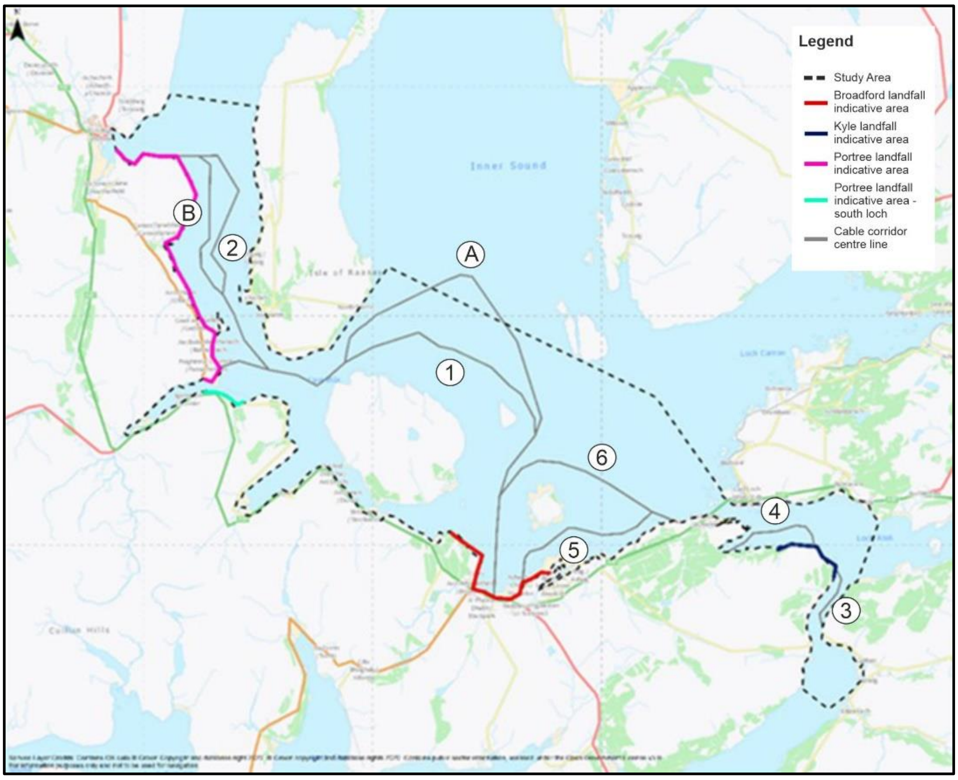
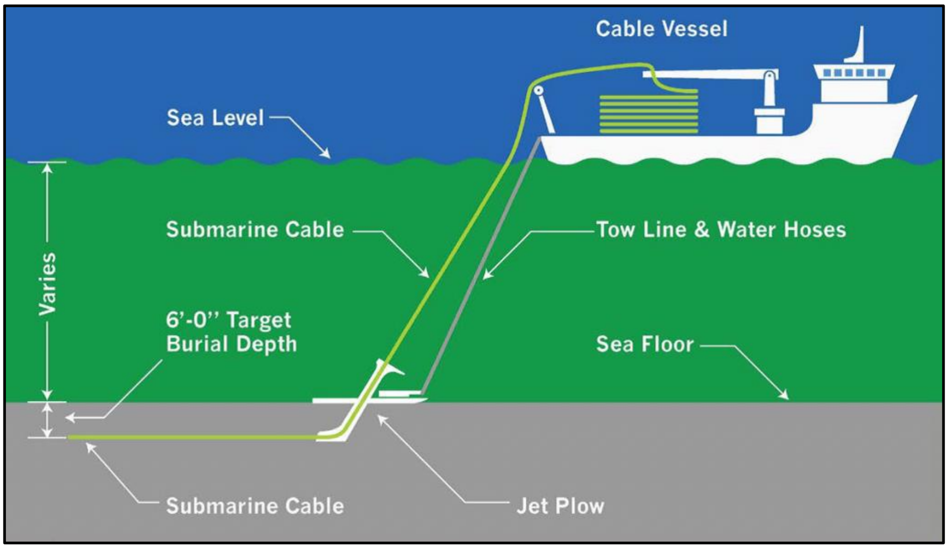


Plate 1.5 – Subsea Cable Installation Method



Section 2

1.4.7 **Table 1.1** provides a description of the subsea cable routes considered, the key constraints and overall suitability. The subsea cable routes within Section 2 comprise two main routes (referred to as Option 1 and Option 2 below), and two alternative sub-options (referred to as Sub-option A and B below). Sub-options do not form options in their own right, but form alternative options within each of the two main routes.

Table 1.1: Subsea Cable Options between Portree and Broadford

Subsea Cable Option	Description of Route	Constraints	Overall Suitability
Option 1 Broadford – north of Scalpay – Peinchorran (24 km in length)	Water depths vary between 25 m and 104 m though data coverage is incomplete. Bathymetry indicates large areas of exposed bedrock, with some accumulation of sediments in depressions. North of Pabay the seabed becomes irregular with high gradients associated with marine escarpments. Mapped tidal velocities peak at 3 knots. This route passes through the Red Rocks and Longay Urgent Marine Protected Area (MPA), and the Inner Hebrides and the Minches SAC. It also crosses areas of identified biogenic reef. A historic munition's disposal site is located approximately 800 m to the northeast of the cable corridor centre line in an area of deep water.	Major constraints concern the MPA, both in terms of its qualifying features (flapper skate) and the potential to result in a barrier effect for elasmobranch species as a result of Electromagnetic Field (EMF) avoidance behaviour. In addition, there is the potential for adverse effects on embryonic flapper skate, alongside a number of other likely pressure pathways. Other constraints concern topography and geology, particularly from Broadford to north of Pabay where the presence of Jurassic sandstone at seabed will likely preclude subsea cable burial for parts of this route. The munitions disposal site also presents a major potential risk to cable installation works.	Low
Option 2 Broadford – north of Scalpay – Portree (34.5 km in length)	As per Option 1, until deviation north towards Portree through Sound of Raasay. Through the Sound of Raasay, water depths vary between 19 m and 80 m though data coverage is incomplete. Bathymetry indicates large relatively smooth seabed and sandy mud within the Sound of Raasay. Mapped tidal velocities peak at 3 knots. The route crosses the Skye - Raasay SSEN Distribution subsea power cable. Low density of commercial fisheries, but shipping activity around Peinchorran and Portree is higher than elsewhere in the study area.	Major constraints similar to those identified for option above and concern the MPA, topography and geology north of Pabay. Within the Sound of Raasay, the seabed is generally smooth and more gently angled, with depressions in the centre of the channel indicating gas or fluid release.	Low
Sub-Option A North of Scalpay	Water depths range between 28 m and 180 m. Between Longay and Pabay, water depths increase with	Major constraints concern the MPA, both in terms of its qualifying features (flapper skate) and the	Low

Subsea Cable Option	Description of Route	Constraints	Overall Suitability
northern extension (15 km in length)	areas of seabed of moderate to steep gradients. Further north the areas of deeper water are characterised by smooth seabed (indicating a sandy or muddy bottom) between steep-sided escarpments. Mapped tidal velocities peak at 3 knots. An historic munition's disposal site is located approximately 500 m to the east of the cable route. The route passes through the Red Rocks and Longay Urgent MPA and is entirely within the Inner Hebrides and the Minches SAC This route option also encroaches into the Sound of Raasay Ministry of Defence (MoD) Exercise and Danger Area, and a moderate density of commercial fisheries is present in the area with high value potting activity. Fishing activity is likely to be more prevalent within the deeper water channels.	potential to result in a barrier effect for elasmobranch species as a result of EMF avoidance behaviour. In addition, there is the potential for adverse effects on embryonic flapper skate, alongside a number of other likely pressure pathways. The proximity of the munitions disposal site also presents a major potential risk to seabed works. Constraints associated with the Sound of Raasay MoD Exercise and Danger Area would require further investigation.	
Sub-Option B Sound of Raasay deep water channel (6.8 km in length)	An alternative deep-water route within the Sound of Raasay, with water depths ranging from 47 m to 123 m. Whilst BGS data coverage is incomplete, seabed substrate is interpreted as sandy mud across much of the route within the deep-water channel., with gentle to moderate gradients. Mapped tidal velocities peak at 3 knots. This route option is entirely within the Inner Hebrides and the Minches SAC. The route also crosses the Skye - Raasay SSEN Distribution subsea power cable. A low density of commercial fisheries is present in the area. Shipping activity around Peinchorran and Portree is higher than in much of the study area.	Given the less challenging topography and the absence of designated areas, from a cable installation perspective this route potentially poses fewer constraints than other route options and, thus, is considered as having Medium suitability.	Medium

1.4.8 The results of the study indicated that subsea cable installation in Section 2 is likely to be very challenging, with a variety of adverse factors that include strong tidal currents, designated marine habitats, areas of rugged/complex bedrock at seabed, a historic munitions disposal site and a MoD Exercise and Danger Area. Commercial fisheries in the area will also need to be taken into consideration. Recent identification of the flapper skate nursery and designation of the Red Rocks and Longay Urgent MPA provide further constraints to a number of potential subsea cable routes.

1.4.9 It was concluded that none of the subsea cable options discussed above would be considered suitable for subsea cable installation when considered in combination. Whilst Sub-Option B is considered as having medium suitability, it requires to be combined with a main route to form a complete subsea route option. As such, it is not proposed to give further consideration to subsea cable as an alternative design solution within Section 2.

Section 3

1.4.10 **Table 1.2** provides a description of the subsea cable routes considered, the key constraints and overall suitability in relation to Section 3 of the Skye Reinforcement Project. The subsea cable routes within Section 3 comprise four main routes (referred to as Options 3 to 6 below, see also **Plate 1.4**).

Table 1.2: Subsea Cable Options within Section 3

Subsea Cable Option	Description of Route	Constraints	Overall Suitability
Option 3 Existing OHL on the Scottish mainland – Kyle Landfall Indicative Area (3 km in length)	Water depths vary between 12 m and 36 m. The 15 m bathymetric contour is very close to shoreline, and the area is characterised by steep-sided rocky slopes. Away from steep flanks, seabed gradients are generally low and the morphology suggests a hard substrate with current scour. Tidal velocities are high with peaks of 8 knots. Located entirely within two SACs.[5] It is also within very close proximity of a NCMPA.[6] No significant interaction with existing seabed infrastructure and a low density of commercial fisheries in the area.	Main constraint is the extremely high tidal current velocity present (peak flows of 8 knots), likely to preclude cable lay vessels that operate using dynamic positioning, meaning that anchor positioning would be required with associated additional anchor handling vessels and anchor impacts on the seabed. Route is also entirely within two SACs and near one NCMPA. There will likely be direct impacts through habitat loss and/or disturbance to sensitive benthic habitats and species.	Low
Option 4 Kyle Landfall Indicative Area – Loch na Beiste	Water depths vary between 39 m and 115 m. The 15 m bathymetric contour is very close to shoreline. On the slopes descending to the middle of the Loch, gradients are generally	The main constraint to laying subsea cable(s) in this location is the high tidal current velocity present (peak flows of 3 knots), likely to preclude cable lay vessels that operate using dynamic	Low

5 the Inner Hebrides and Minches SAC (designated for harbour porpoise Phocoena phocoena), and the Lochs Duich, Long and Alsh Reefs SAC (designated for Annex I reef habitat).
6 the Lochs Duich, Long and Alsh Nature Conservation Marine Protected Area (NCMPA) (designated for burrowed mud and flame shell beds).

Subsea Cable Option	Description of Route	Constraints	Overall Suitability
(4.7 km in length)	>20°. Tidal velocities are high with peaks of 3 knots. Located entirely within the two SACs and is also located within the NCMPA as mentioned for Option 3. Due to this, the route is near burrowed mud and recorded flame shell (*Limaria hians*) beds. Extensive Flame shell beds are rare and of conservational importance. No significant interaction with existing seabed infrastructure, but a moderate density of commercial fisheries in the area with high levels of shipping activity in the vicinity of Skye bridge. A number of wrecks have also been recorded in the area surrounding the western landfall within Loch na Beiste. A SSEN Distribution subsea power cable also runs adjacent to this route to the northwest.	positioning, meaning that anchor positioning would be required with associated additional anchor handling vessels and anchor impacts on the seabed. The NCMPA and SAC designated areas are major constraints. There will be likely direct impact through habitat loss and/or disturbance to sensitive benthic habitats and species. Wrecks and a nearby SSEN Distribution cable may also be constraints.	
Option 5 West of Skye bridge – Harrapool (8.7 km in length)	Water depths vary between 11 m and 23 m though data coverage is incomplete. Where data is available, bathymetry indicates exposed bedrock escarpments. Mapped tidal velocities have peaks of 2 knots. The route option is entirely within the Inner Hebrides and the Minches SAC and it also passes through a designated seal haul-out site at Pabay and Ardnish Peninsula. There is no significant interaction with existing seabed infrastructure and a low density of commercial fisheries in the area, though potting activity is likely to be present in the vicinity.	The major constraints for this route option concerns the shallow water, designated areas and rock escarpments, together with incomplete data, all of which increases the installation risk of subsea cables. Bathymetric data identifies regions of infralittoral rock and biogenic reef.	Low
Option 6 West of Skye bridge – north of Pabay – Broadford (13.5 km in length)	The water depths in the east of this route range between 11 m and 91 m. North and northwest of Pabay the seabed is irregular with locally high gradients associated with escarpments (generally <12° though data coverage incomplete). The approach to Broadford is more gently	Water depths may cause difficulties in the cable laying operation due to the draft of the cable lay vessel limiting access. Extensive areas of exposed bedrock will likely preclude cable burial and increases the need for rock protection. Similarly, localised high seabed gradients	Low / Medium

Subsea Cable Option	Description of Route	Constraints	Overall Suitability
	sloped. Bathymetric data indicates extensive areas of exposed bedrock. Mapped tidal velocities peak at 2 knots. The route option is entirely within the Inner Hebrides and the Minches SAC and a moderate density of commercial fisheries is present in the area.	associated with escarpments also increases the risk of cable burial and/or installation.	

1.4.11 The results of the study indicated that subsea cable installation in the area is likely to be very challenging, with a variety of adverse factors that include strong tidal currents, designated marine habitats and areas of rugged/complex bedrock at seabed.

1.4.12 It was concluded that none of the subsea cable options discussed above would be considered suitable for subsea cable installation within Section 3 of the Skye Reinforcement Project. As such, it is not proposed to give further consideration to subsea cable as an alternative design solution within Section 3.