503_SHEPD_HSM_24_ERISKAY-BARRA

ERISKAY – BARRA 2 ENGINEERING JUSTIFICATION PAPER

Scottish & Southern Electricity Networks

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1 Executive Summary

1.1 Summary

Background

This Engineering Justification Paper (EJP) for Scottish Hydro Electric Power Distribution (SHEPD) sets out the investment required for the Eriskay – Barra 2 11kV subsea cable. It also provides the associated evidence and justification to support Ofgem's assessment of this investment. As this re-opener submission seeks funding for the Eriskay – Barra 2 (E-B2) cable investment, this EJP reflects on currently available data where appropriate and builds upon the initial submission which was made to Ofgem as part of SHEPD's draft RIIO-ED2 business plan submission, prior to the cable being removed from SHEPDs baseline and moved to the HOWSUM.

The E-B2 11kV subsea cable provides the sole network connection to the Isle of Barra in the Outer Hebrides of Scotland. This cable forms part of an 11kV network which is supplied from Pollachar on South Uist. The 11kV network operates from South Uist, across to the Island of Eriskay, via an 11kV subsea cable and a 11kV causeway connection, before the single 11kV subsea cable (Eriskay – Barra 2) connection between the Islands of Eriskay and Barra. The cable also allows Barra Power Station (BPS) to support the 11kV network under certain outages on the Pollachar 11kV network. The E-B2 cable is 9.656km long and was manufactured in 2013. The island of Barra was previously served by the Eriskay – Barra 1(E-B1) cable and subsequently had two 11kV connections when the E-B2 cable was installed as a replacement for E-B1 cable which had reached the end of its operational life. The E-B1 cable was left in service upon replacement, temporarily providing two supplies to the island until the cable failed and was abandoned. Subsequently the island of Barra has since been supplied by a single cable connection, with BPS providing back up contingency supplies.

Drivers for change

Through network assessment and visual inspections, the E-B2 cable has been found and assessed to be in a poor external condition. This results in the cable having a high network risk and should it fail in service could incur associated impact costs. Although the cable is currently identified in SHEPD's Invest system, which follows the Common Network Asset Indices Methodology (CNAIM) v2.1, to be a Health Index (HI) 3 cable, the cable is predicted to reach HI5 by the end of RIIO-ED2. This cable has therefore been deemed in need of intervention to reduce the associated probability of failure and risk associated with wider network.

The E-B2 cable has significant portions of burial along its route and therefore it is challenging to gain a complete visual end to end inspection of the cable. Areas of deterioration/damage have been identified in areas where the cable was exposed during inspection. It is likely given the shifting seabed conditions in this area, that different areas of the cable may be exposed each time an inspection is conducted and therefore without seeing the full length of the cable the condition could be even worse than SHEPD's ROV inspections have been able to detect thus far, given some areas will periodically been covered and uncovered by sand and sediment. Previous shore-end remedial works have also taken place on this cable to re-bury and protect the shore ends.

SHEPD has been assessing whole system solutions for the Outer Hebrides, looking at the larger islands of Lewis, Harris, North Uist, Benbecula and South Uist. These islands are currently supplied via SHEPD's 33kV network from Ardmore on Skye. Wider network reconfiguration and reinforcement is proposed for these parts of the network and further details can be found in the associated Hebrides and

Orkney Whole System UM Core Narrative and associated EJPs. Whilst conducting wider whole system analysis, no major network changes were highlighted or proposed for the 11kV network supplied from Pollachar,. i.e. no alternative source or credible network route was identified to supply the wider islands by connecting through Barra / Eriskay, and hence the islands will remain supplied on the 11kV network from Pollachar. The islands of Eriskay, Barra and Vatersay are connected to Pollachar on South Uist via 11kV network - this can be seen in Figure 1. This circuit is made up of overhead line, underground cable and subsea cables and will remain with this arrangement for the long term.

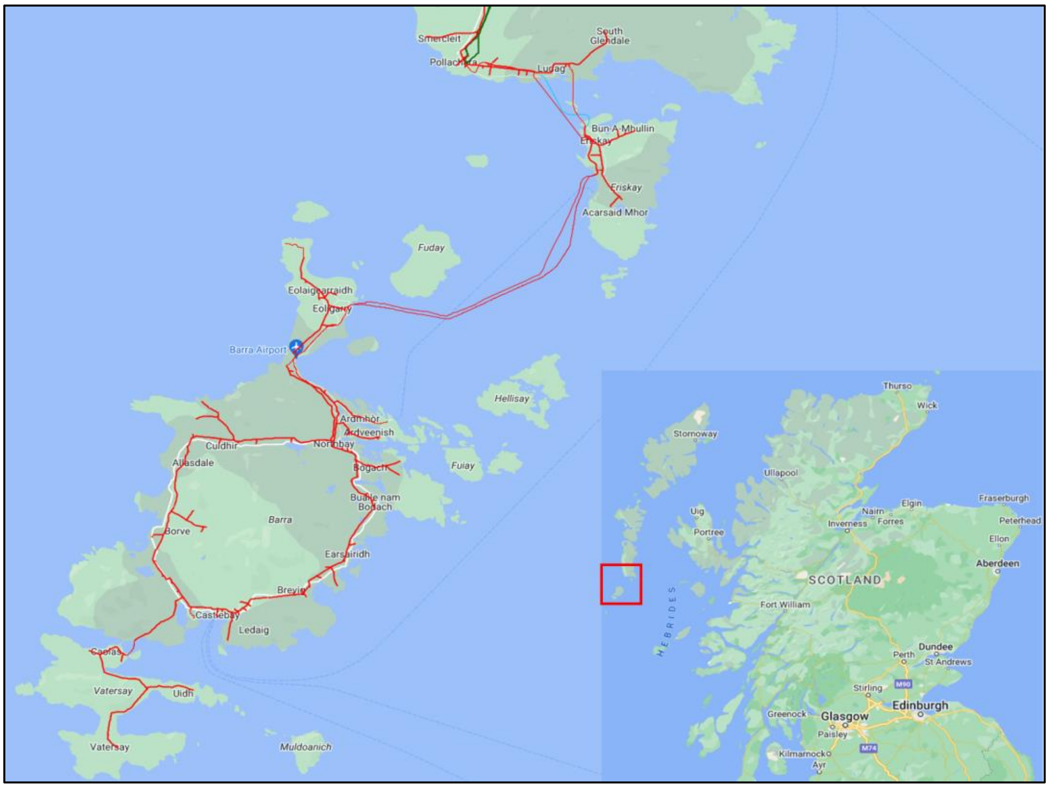

Figure 1: Location and overview of island group

As part of securing this section of network and improving future network and cable resilience, alongside the investment on the Eriskay – Barra cable crossing, additional investment is proposed on the cable between South Uist and Eriskay on the same circuit, further upstream. The combination of these investments as well as the wider whole system investment on the Outer Hebrides should reduce the reliance on Barra diesel power station starting in RIIO-ED3. Additional details on proposals for the South Uist - Eriskay subsea cable can be found in Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris).

It is therefore proposed by SHEPD to replace the existing E-B2 cable based on the cable condition and associated network risk. SHEPD proposes to install a new 11kV subsea cable connection between Eriskay – Barra 3(E-B3) in a similar location to the existing cable, whilst maintaining the existing E-B2 cable in service until failure, at which time the future investment options for that cable will be assessed. This will provide the island with 2 x 11kV cable connections, securing supplies. This cable proposal does not affect any of the wider investment currently planned within the HOWSUM and can therefore be assessed on its own merits at this time. The project will have its own design consent and installation timeline and will take an alternative contracting strategy. This project is ready for assessment.

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Ofgem's provisional assessment of this project when submitted as part of SHEPD's RIIO-ED2 Business Plan was that it was justified.

Options analysis

SHEPD has assessed six different options for the replacement of the existing submarine cable. All options explore traditional subsea cable installations of varying numbers and sizes.

Option four, the augmentation of the existing subsea cable with a similar sized cable has been determined as the best technical and financial long term network solution. This conclusion was further supported by outputs of the CBA which confirmed, based on option NPVs that it is better than the other investment options.

CBA and overall cost

Detailed CBA has been conducted at all key stages of the project. This CBA considered all six options from the options analysis. An overview of the results has been provided in Table 1.

Option	10 year NPV	45 year NPV
1. Do Nothing - Replace on Failure	(£3.29m)	£8.02m
2. Replace - Similar Sized Cable	(£2.46m)	£10.67m
3. Replace - Larger Cable	(£2.71m)	£10.07m
4. Augment - Similar Sized Cable	(£2.42m)	£11.11m
5. Augment - Larger Cable	(£2.67m)	£10.51m
6. Reinforcement - two new cables	(£6.55m)	£1.68m

Table 1: Eriskay – Barra 2 cable replacement CBA

The current forecast cost for the optimal solution is [redacted] (2020/21 prices) – see Table 2. This has utilised Ofgem agreed unit rates for HV subsea cables defined as part of SHEPD's baseline RIIO-ED2 Business Plan plus an assumed [redacted] mobilisation fee. SHEPD proposes to include this scope of work alongside other baseline subsea projects being delivered at a similar time to drive cost efficiencies and reduce network outages to ensure we can deliver to the agreed rate.

2020/21 prices	Class 2 Estimate, January 2024
Subsea Mobilisation	[redacted]
Subsea Cost	[redacted]
Onshore cost	[redacted]
Total:	[redacted]

Table 2: Eriskay – Barra 2 cost estimate

Solution delivery

SHEPD has delivered a number of similar type projects over a number of years and has an in house, specialist subsea team which has the skills and experience required to design and manage the delivery of these works. Over a number of years SHEPD has built strategic relationships with marine contractors for survey and installation works and has no concerns over being able to deliver this project.

There are currently challenges in the marine installation market over vessel availability and resource requirements. This has mainly been driven through a large demand for offshore renewables and telecoms works. This makes it more challenging to contract with marine partners and associated delivery slots require to be booked far in advance to secure required days. As part of previous lessons learned, SHEPD now aims to carry out planned cable replacement in spring / summer months where consents and contractor availability allow. However, this is the busiest period for securing vessels and means installation costs can be higher due to competition. This does however provide more certainty over final costs can reduces the likely associated weather risk with conducting installations in the autumn winter period. The associated installation of the new onshore cable and overhead line to tie the subsea cable into the network are manageable and business as usual activities for SHEPD.

SHEPD has high confidence in being able to deliver the proposed investment.

Conclusion

SHEPD has conducted options assessment and CBA to support the intervention on the existing Eriskay – Barra 2 subsea cable. This analysis suggests that the existing cable should be augmented with a new similar sized subsea cable, within the RIIO-ED2 price control period.

SHEPD was provided development funding for HOWSUM projects under RIIO-ED2 Final Determinations. We have estimated that development costs for the Eriskay – Barra 2 subsea cable replacement are circa [redacted] .The final proposed solution for this cable is estimated to cost [redacted]. SHEPD is therefore seeking to recover [redacted] of additional funding relating to this project at this time under the HOWSUM reopener, provided for in Special Condition 3.2 Part O.

The benefits associated with delivery of this project are significant and include improved asset health and reliability, contribution to security of supply and meeting demand and generation needs as part of a whole system solution out to 2050 and beyond.

On the basis of this intervention being discrete in the context of its geography and network impacts, and the specification not being driven by wider Outer Hebrides whole system proposals within ED2, we consider that it can assessed separately.

Further detail on all key areas is included in the following sections. This EJP should be read in conjunction with the Hebrides and Orkney Whole System UM Core Narrative, Appendix 5B – Eriskay-Barra CBA, and the wider submission documents.

2 Investment Summary Table

Within this paper all price bases are in 2020/21 prices. As part of the Cost Benefit Analysis (CBA) a capitalisation rate of 85% and a pre-tax WACC of 4.12% have been utilised.

Name of Scheme/Programme	Eriskay – Barra 2 11kV Subsea Cable Intervention	
Primary Investment Driver	CV7a Asset Replacement – Existing health condition and network risk.	
Scheme reference/ mechanism or category	503_SHEPD_HSM_24_ERISKAY-BARRA	
Output reference/type	ADDITION OF CIRCA 10KM OF 11KV SUBSEA CABLE ADDITION OF CIRCA 0.5KM HV U/G CABLE (NON PRESSURISED)	
Cost	TOTAL: HOWSUM DEVELOPMENT FUNDING: **NET FUNDING SOUGHT:**	[redacted] [redacted] [redacted]
Delivery Year	2026/27	
Reporting Table(s)	CV7a Asset Replacement; R3	
Outputs in RIIO RIIO-ED2 Business Plan	No – project sits under the HOWSUM. HOWSUM Development Funding (HDF) has been provided as part of SHEPD's RIIO-ED2 settlement for HOWSUM project development costs. Eriskay-Barra development costs in RIIO-ED2 are estimated at [redacted] (see also Hebrides and Orkney Whole System Core Narrative, Table 5).	
Spend Apportionment	**RIIO-ED2**	**RIIO-ED3+**
	[redacted]	N/A
MVA released	N/A	N/A

Table 3: Eriskay-Barra investment summary table

3 Appendices Summary

Table 4 summarises the appendices.

Appendix	Summary of content
Appendix 5B – Eriskay-Barra CBA	Full details of project cost benefit analysis

Table 4: Summary of appendices

4 Introduction

This EJP covers the asset replacement investment required to manage the Eriskay – Barra 2 11 kV subsea cable, which provides supplies to 1,019 customers on Barra and Vatersay with the single circuit. There were previously two subsea cables, one of which has failed. This EJP addresses this failure and restore the second circuit.

The Eriskay - Barra submarine cable was identified as a cable qualifying for intervention as part of SHEPD's RIIO-ED2 business plan submission. The cable has been selected for intervention due to the existing asset health and high associated network risk. The cable is forecast to reach HI5 by the end of RIIO-ED2 and should it fail would require the long-term operating of BPS until the cable was repaired or replaced. The proposed solution will reduce this risk by augmenting the existing circuit with a new 11kV cable between Eriskay and Barra which will tie into existing network infrastructure. This cable will follow the latest route engineering design and protection standards to extend and maximise cable life in this area. The current installations have been surface laid with portions of self-burial. SHEPD's subsea cables are now fully risk assessed and studied to ensure optimal levels of protection and burial are provided. These works stabilise and protect the cable, preventing excessive cable movement/abrasion and risk if interaction with third parties. This will ensure the cable will meet the minimum cable design life of 25 years but with the aim of achieving a 45 year cable life.

This project forms part of a whole system approach taken on the Outer Hebrides. Over the course of RIIO-ED2 there are five subsea cable investments proposed relating to the overall electricity network on the Outer Hebrides. This cable forms an integral part of a whole system approach ensuring the network is fit for purpose for the long-term and supports a transition to net zero.

This paper recommends the existing subsea cable is augmented with a new similar sized subsea cable, providing two subsea cable links between Eriskay and Barra. This will improve circuit reliability and network security whilst ensuring project costs can be as efficient as possible through planned intervention, avoiding fault impact costs and potentially higher replacement costs attributed to distressed buyers under fault scenarios.

5 Background Information

5.1 Existing Network Arrangements

The Eriskay - Barra 2 11 kV submarine cable is 11 years old, supplies 1,019 customers and has 0.9 MW of generation which is constrained when the supply is interrupted. The existing cable is 9.656km long and currently HI3 C2. The cable is forecast to increase to an HI5C2 by the end of the RIIO-ED2 period. There are two subsea cables shown on the network; Eriskay - Barra 1 and Eriskay - Barra 2. The Eriskay – Barra 1 cable has failed and is out of service, however, the onshore connection points on Eriskay and Barra remain so therefore could be reused to connect a new cable. This 11kV network is fed from Pollachar Primary S/S on South Uist via Eriskay. The Eriskay – Barra 1 cable was previously decommissioned following a fault. The cable routes and subsea cable and network arrangements are shown in Figure 2 and Figure 3.

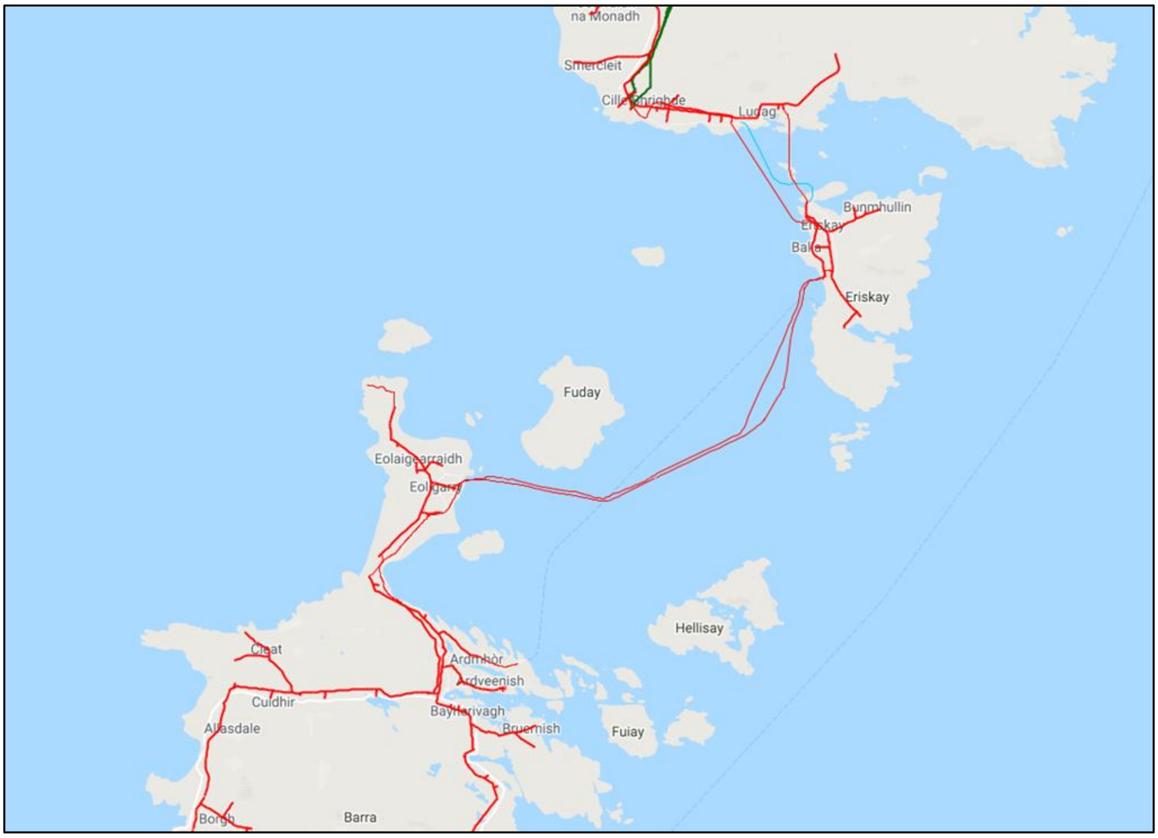

Figure 2: Eriskay Barra 2 11 kV cable route

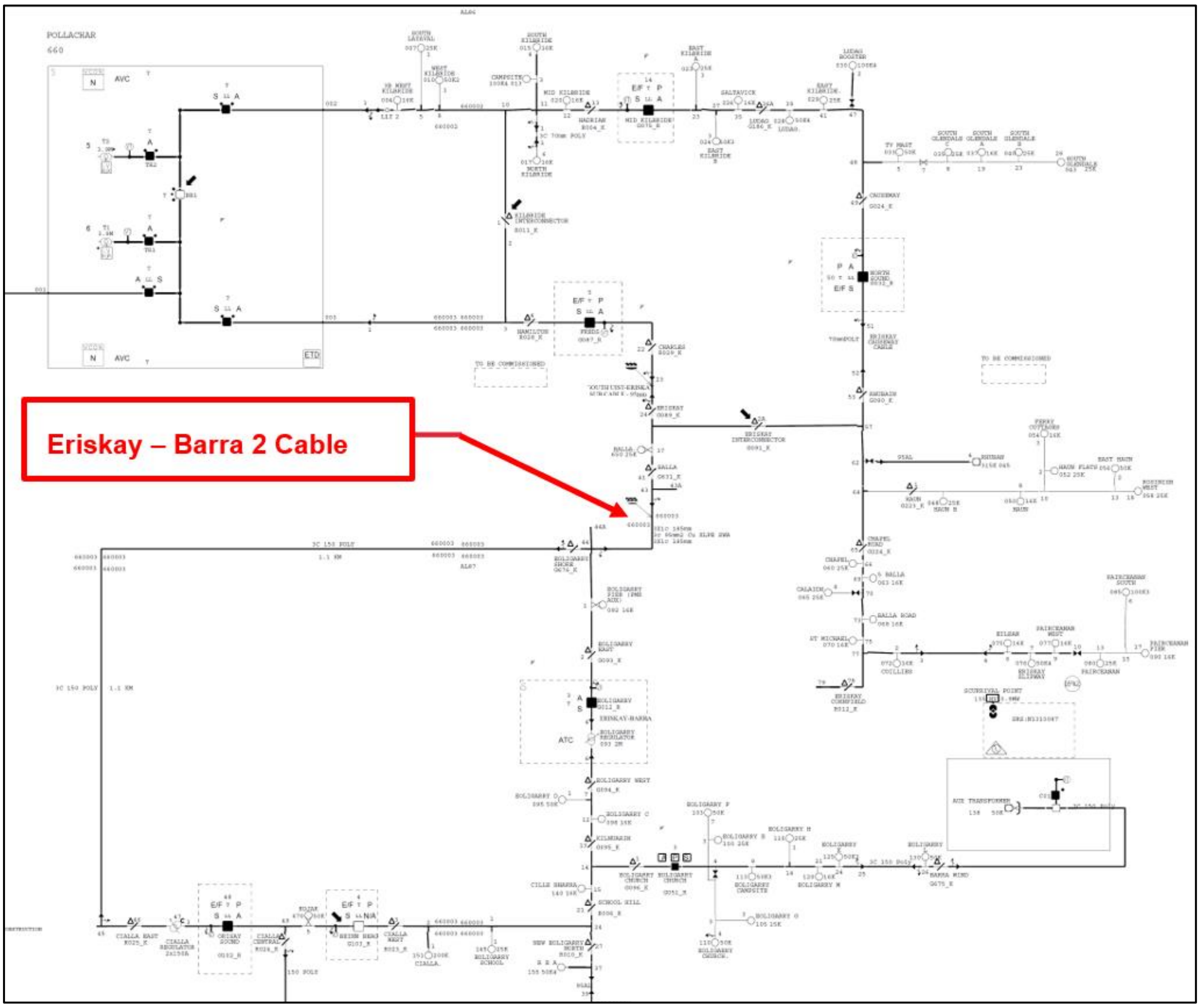

Figure 3: Eriskay – Barra 2 11 kV subsea cable and network arrangement

Although the Eriskay – Barra 2 cable is only 11 years old, the cable has already been found through visual inspections to be in poor condition and additionally, of the six cables that were installed with this cable type, three have failed during the RIIO-ED1 period. This gives cause for concern that this cable could fail in the near future. This cable also has a high impact cost given the nature of the radial circuit, the number of customers supplied and that Barra Power Station will be required to run to maintain supplies in the event of a failure. There is currently no second connection to the island for restoration.

5.2 Load Forecast for Eriskay – Barra Cable

The current maximum demand on the Eriskay – Barra 2 cable is 1.79 MVA (11.2% of the cable rating). Based upon the 2022 CT Winter Maximum DFES from Pollachar substation it is anticipated that, on average, the 11kV feeder which the Eriskay – Barra 2 cable is on will experience an average load growth per year of 1.98% between 2023 and 2050. Therefore, forecast demand by 2050 is expected to be 3.1 MVA. The forecast demand projection anticipated to be seen by the circuit is shown in Figure 4. This also highlights that demand is not forecast to continually grow significantly and tails off. This provides reassurance that the new proposed asset will be sufficient to provide for network needs over the asset life. The proposed new cable would be an 11kV 95mm^2 DWA Cu XLPE cable rated at 5.62MVA. This means that by 2050 the cable would only be loaded to 55.2%.

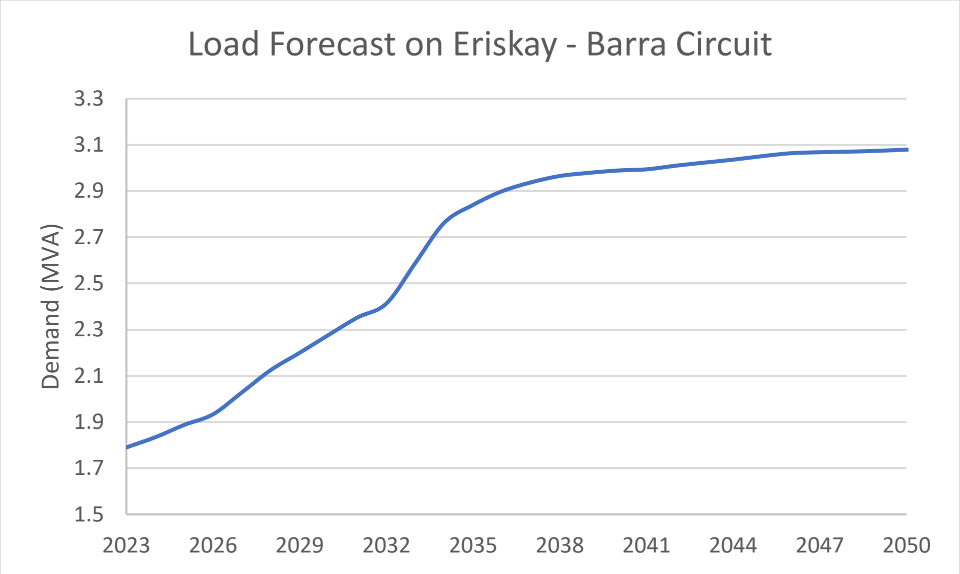

Figure 4: Load Forecast Eriskay – Barra 2 11 kV Feeder

5.3 Existing Asset Conditions

The Common Network Asset Indices Methodology (CNAIM) models maintained by SHEPD provide a Health and Criticality Index for each individual asset. This is calculated using a variety of asset-specific data which includes basic parameters in addition to the observed and measured condition (where available) of each asset.

The Eriskay – Barra 2 11kV subsea cable is HV 95 XLPE SWA [redacted] type and has been in service for 11 years. This cable is a 33kV cable which is operated at 11kV. Visual inspections have already confirmed the cable is in poor condition and additionally, of the six cables that were installed with this cable type, three have failed during the RIIO-ED1 period with a fourth, the Coll – Tiree cable, being replaced within RIIO-ED2 under SHEPDs baseline programme. The cable has a current Health Index of HI3 with a Criticality index of C2.

An example of the armour corrosion and deterioration are provided in Figure 5. This shows exposed, broken and corroded armour. There are also a number of instances along the cable route where all outer serving is missing and the armour is exposed - an example is provided in Figure 6. Additional cable damage could also be present on sections of the cable which were not visible during the inspection.

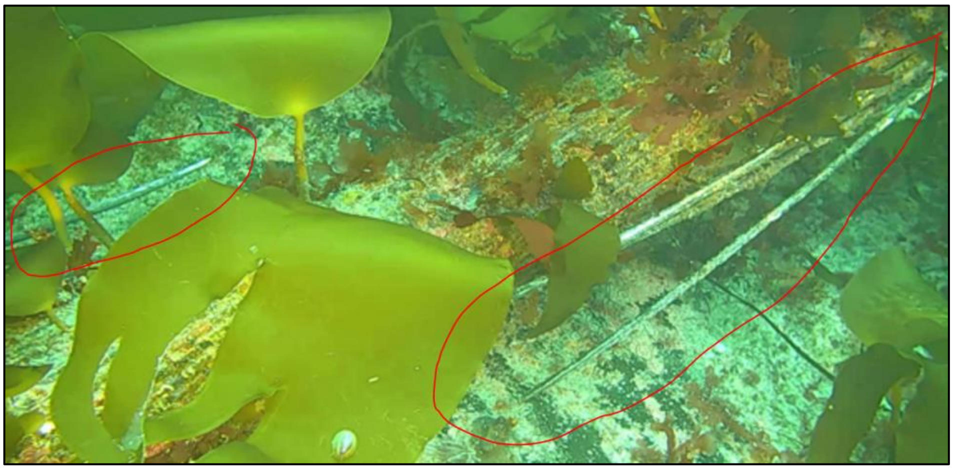

Figure 5: Evidence of cable armour damage and corrosion

Figure 6: Evidence of exposed armour and cable deterioration

5.4 Existing Operational Issues

There are not currently any operational issues with this specific circuit, however access to the existing Eriskay subsea landing location is challenging.

Voltage regulators are in place on this network to support maintaining network voltages within acceptable limits. These are normal network assets and network parameters are assessed through standard planning studies and new connections to ensure the statutory limits are managed effectively.

There is only a single subsea cable feeding to Barra and onward islands as things stand. In the event of an outage of this cable, Barra Power Station is required to support the 11kV network.

5.5 Network Analysis Summary

Network studies conducted on PSS Sincal confirm that a 95mm^2 11kV Subsea cable will be suitable for network requirements out to 2050 based on DFES forecasts. This is based on utilising stock 11kV 95mm^2 cable rated up to 5.62MVA.

Network studies have considered demand growth on the circuits out to 2050 in line with the CT DFES scenarios. These studies highlight no thermal or voltage issues associated with the new proposed solution. The studies confirmed that the new cable can support the 11kV network and surrounding islands, under worst case N-1 contingencies.

There are no concerns with fault levels.

5.6 Regional Stakeholder Engagement and Whole Systems Analysis Summary

Through SHEPD’s work with Regen on the DFES scenarios, multiple island stakeholder groups are engaged to allow a better understanding of future demand and generation requirements on the islands. A wide range of stakeholders have been consulted by Regen as part of the works to develop the 2021 and 2022 DFES scenarios and will be further engaged in the development of subsequent versions of the prediction models. This includes details of future connections activities, industrial electrification, local development plans and independent stakeholder ambitions.

SHEPD is continuing to directly engage with key stakeholders in relation to the wider whole system analysis and solution for the Outer Hebrides. This has included recent HOWSUM webinars and bilaterals, with further engagement planned throughout 2024.

The SHEPD Subsea Cables team holds regular engagement meetings with more than twenty key stakeholders ranging from Marine Scotland to environmental agencies such as SEPA, NatureScot, Historic Environment Scotland and RSPB to local authorities including Highland Council, Argyle and Bute Council, North Ayrshire Council and Comhairle nan Eilean Siar. Fishing industry representatives are also an important stakeholder group with Scottish Fishermen’s Federation, Orkney Fishermen’s Association, Clyde Fishermen’s Association and Western Isles Fishermen’s Association, among others, engaged every couple of months or more often.

Community Engagement

It is important that we engage thoroughly with communities on either side of the cable, keeping them informed and updated on our progress and helping them to understand both the implications and benefits delivered by the project. As such we will maintain a steady stream of engagement with elected members, community councils and those customers neighbouring the sites. Presentations on previous subsea projects will be delivered and more engaged members of the community are extended invitations to visit. As such they are able to explain the process in layman’s terms to their neighbours etc. This is something which may be implemented on this project.

Tertiary Engagement

It is realised that works may impact not only on communities living adjacent to our sites, but to those travelling through these regions, particularly ferry passengers and drivers. As such SHEPD aims to blend the use of traditional communication methods with digital elements. Postcards and posters may be used to catch the eye of travellers using ferry services, petrol stations and local shops. Banners have previously been utilised on ferry services and SHEPD could consider the use of digital screens in larger ferry terminals. Radio advertising may also be used to alert drivers to our works as they travel. Press releases will be issued to local media to ensure detailed coverage, with newspaper advertising supporting reinforcing such messaging. All of these platforms will point towards web pages where more detailed information can be viewed.

Please refer to the Hebrides and Orkney Whole System UM Core Narrative for more information on recent and planned stakeholder engagement activities.

5.7 Flexible Market Viability

This investment decision is not being driven through anticipated load growth or new connections, but from an asset health, associated network risk and security of supply perspective as part of SHEPD's whole system planning. SHEPD is committed to considering flexible alternatives to traditional engineering solutions on our networks.

SHEPD requires to maintain this connection as part of the wider 11kV network supplying Eriskay, Barra and Vatersay. This element of network infrastructure is also key to any future reduction of use in, planned repurposing, mothballing or removal of Barra Power Station. Flexibility calls to date have identified no services available in this area; however we will continue to monitor this as future calls are progressed. Our Distributed Embedded Generation (DEG) strategy, taking account of Barra Power Station, will be included in more detail in our January 2025 HOWSUM application.

5.8 Confidence Table

Table 5 provides an indication of our confidence levels in each of the sections which have been analysed/utilised as part of the solution assessment.

Confidence Factor	Certainty (High, Medium, Low)	Comments
Load Forecast	Medium	Data is not collected/recorded for the 11kV level as part of the DFES. Data associated with 33kV primary and similar load growth profile applied to the existing 11kV load. This is thought to be representative of potential growth on the 11kV network in this area.
Existing Asset Condition	Medium/High	Offshore ROV inspections in April 2021 confirmed there to be areas of cable damage and armour exposure on the cable. The existing subsea cable has a number of sections which are covered/buried between landing locations. There could be instances of cable damage along the route which are not visible. Additionally, no electrical testing is performed on SHEPD's subsea cables. The subsea cable could be in a worse condition than assume. The remaining onshore assets are much

Confidence Factor	Certainty (High, Medium, Low)	Comments
		more visible and easily accessible and SHEPD has high confidence in their condition assessment.
Existing Operational Issues	High	This is a long-established network.
Connections Activity	Medium	Connections are regularly changing, and new applications can be received at any time. However, we had reasonable certainty based on DFES analysis and research and connections pipeline at time of PFE2 failure.
Regional Stakeholder engagement	Medium	Outer Hebrides whole system webinars have been held also with the offer of bilaterals. Further engagement undertaken through DFES and wider community engagement sessions.
Flexible market Viability	Low/Medium	There are a number of emerging technologies which may be possible considerations for flexibility as part of a long-term solution. The islands of Barra and Vatersay have limited flexible generation installed at the moment.
Funding Position	Medium	We have agreement to use the HOWSUM, and the outcome of the submission is subject to Ofgem's assessment. Based on our analysis of island needs we believe we have identified the correct solution for implementation at the correct time.

Table 5: Confidence table

6 Summary of Options Considered

6.1 Summary of Options

This section indicate- the list of options which were considered as part of the overall investment solution for the Eriskay - Barra subsea cable intervention.

Under all scenarios where a new cable is installed, it is assumed that the new cable will require an install length of up to 10.7km. Given two cables (an in service and out-of-service) are already present on this route, a new offshore route is likely to require a longer route with suitable cable crossings and micro routing required to avoid seabed features which could pose a threat to asset life. It is anticipated at this stage that the new installation could be up to 1km longer than the existing route and as such all options assume a new installed length of 10.7km with associated costs.

- Option 1: Do-Minimum – Replace on failure.
- Option 2: Planned replacement with similar sized cable.
- Option 3: Replace with a larger 185 mm² cable.
- Option 4: Augmentation with a similar sized cable.

- Option 5: Augmentation with a larger cable.
- Option 6: Installation of two new cables on the existing route.

6.2 Options comparison table

Table 6 provides a summary of the six investment options under consideration along with the advantages and disadvantages associated with each.

Options	Description	Advantages	Disadvantages	Total cost
1. Do-Minimum – Replace on failure.	Continue to operate the existing cable until it fails, at which time the cable would be replaced.	Maximises existing asset life and may defer expenditure beyond RIIO-ED2.	Would be out of SHEPD's control as to when replacement occurs. Costs would be greater than planned replacement. Would incur impact costs and network outage. Would place strain on internal resource at time of fault. Restoration time would be unknown and subject to cable stock and consents.	[redacted]
2. Planned replacement during RIIO-ED2.	Replace the existing subsea cable with a new 95mm^2 cable.	Improves HI and provides new life cycle. Reduced probability of failure.	Remains single subsea cable.	[redacted]
3. Replace with a larger 185 mm^2 cable.	Replace the existing subsea cable with a new larger 185mm^2 cable.	Improves HI and provides new life cycle. Provides for future load and generation growth.	Remains single circuit security. And risk of impact costs despite improving the reliability with the new circuit	[redacted]
4. Augmentation with a similar sized cable.	Install a new 95mm^2 cable but maintain the existing cable in service.	Similar cost to replacement. Provides N-1 security on the subsea cable for the remainder of the existing cable life improving circuit reliability and security and	Additional inspection & maintenance costs associated with having two assets instead of 1.	[redacted]

Options		Description	Advantages	Disadvantages	Total cost
			reducing usage of diesel generation.		
5.	Augmentation with a larger cable.	Install a new larger capacity cable but maintain the existing cable in service.	Provides N-1 on the subsea cable for the remainder of the existing cable life improving circuit reliability and security and reducing usage of diesel generation.	Additional inspection & maintenance costs associated with having two assets instead of 1.	[redacted]
6.	Installation of two new cables on the existing route.	Replace the existing subsea cable with two new subsea cables.	Provides two new circuits with additional back up contingency.	Highest cost. Finding two new suitable offshore routes may be challenging and could result in requirement for additional infrastructure and switching.	[redacted]

Table 6: Summary of investment options

7 Detailed Option Analysis

This section contains details of the options analysis that was undertake for each of the technically feasible solutions. Option 4 has been determined as the preferred solution. It is anticipated that any new cable installed would follow a similar route to the existing cable route shown in Figure 2.

7.1 Option 1: Do Nothing - replace on failure

The “Do Minimum” Option is for the replacement of the cable to be performed on failure.

In the event of a cable failure, supplies to 1,019 customers would be interrupted and 0.9MW of generation constrained off until re-routing of the network is complete. All customers can be supplied by an alternative source. However, the generation will be constrained until the fault is repaired. The model has assumed this will be for a period of six months to allow for mobilisation of resources to replace the cable.

The constrained generation costs during the outage are estimated at [redacted].

The emergency installation of 10.7 km of subsea cable, following a similar route to the existing cable, has been estimated based on the planned replacement cost [redacted]. This provides for an equivalent size cable (95 mm²) to provide capacity of 5.62MVA which would satisfy the demand forecast until at least 2050.

This option avoids any initial cost of intervention and, should the cable not fault over the price control, will defer expenditure beyond RIIO-ED2. However, the cost of an emergency replacement would be higher than a planned replacement if the cable fails and it incurs the impact and environmental cost. The NPV over 45 years for this option is £8,020,000, based on the CBA.

This option was rejected as it would incur impact cost, constrained generation cost and reputational damage. In addition, the replacement in an emergency would [redacted].

7.2 Option 2: Planned replacement during RIIO-ED2

Replacing the cable with a new 95 mm² XLPE Cu DWA subsea cable will impact the Health Index and Probability of Failure, resulting in a change to the characteristics set by the age and condition of the cable. The new cable will be connected to the existing network points and the old cable disconnected. This option is the planned replacement of the cable during RIIO-ED2 with a new 95 mm2 cable. This will avoid the costs incurred in the event of a failure. This option would keep the asset in the marine environment.

The replacement 10.7km of subsea cable would be following a similar route to the existing cable and has been estimated at a cost of [redacted].

The NPV benefits calculation for this option outturns a value of £13,580,000 within the CBA.

This option is considered the fall-back option should the preferred option not be able to progress this is due to this option having a lower NPV than the preferred option.

7.3 Option 3: Replace with a larger 185 mm² cable

This option is similar to option 2 but laying a new 185 mm² (8 MVA) subsea cable rather than the like for like replacement in option 2. This option would cater for additional or unforeseen growth up to and beyond 2050, but at higher initial cost. This option retains a single subsea cable and potential risk of an interruption and the impact costs. At present it is considered over engineered to proceed with this option given there would be additional cost for unused capacity. Additionally, SHEPD would have to procure new cable or use 33kV 185mm² stock cable which is earmarked for other projects and stored for emergency fault replacements.

The cost of this option is estimated at [redacted].

The NPV benefits calculation for this option outturns a value of £12,970,000 within the CBA.

This option was rejected as the higher cost does not provide any material additional benefits above the preferred option or the fallback option.

7.4 Option 4: Augmentation with a similar sized cable

This option is broadly similar to option 2, with the installation of a new 11kV 95 mm² XLPE Cu DWA subsea cable but retaining the existing cable in service. This option would incur additional costs for connection into the 11 kV network on Eriskay and Barra and would also result in increased maintenance and inspection costs. However efficiency is likely to be gained if inspecting two parallel cables and there is some existing onshore infrastructure available that the new cable could tie into.

This would provide enhanced security with two subsea circuits until the existing cable became faulty. Given the existing cable is 11 years old, the cable may last longer than anticipated. This option will maximise the asset life of the existing asset.

The cost of this option is estimated at [redacted].

The NPV benefits calculation for this option outturns a value of £14,070,000 within the CBA.

This option has been selected as the preferred option, given it's the best NPV and provides additional network security, reduced network risk and could reduce the need for Barra Power Station in the interim.

7.5 Option 5: Augmentation with a larger cable.

This option is similar to option 4 but utilising a 185 mm² cable instead of the 95 mm². This would cater for any additional potential growth, however on existing growth prediction levels this would not be necessary.

The cost of this option is estimated at [redacted].

The NPV benefits calculation for this option outturns a value of £13,460,000 within the CBA.

This option was rejected as the higher cost does not provide any significant additional benefits over the preferred option to justify the expenditure.

7.6 Option 6: Installation of two new cables on the existing route

This option was considered due to the improvement in reliability and security provided by two new cables, which would ensure that in the event of a subsea cable fault supplies would be maintained and avoid impact costs and constraint costs. The laying of the two cables together under the same contract is expected to allow cost saving of [redacted] on the second cable compared to the first. This has been costed on 95 mm² cables and would provide firm N-1 capacity against a subsea cable fault.

The cost of this option is estimated at [redacted].

The NPV benefits calculation for this option outturns a value of £4,560,000 within the CBA.

This option was rejected as the higher cost does not provide significant additional benefits to justify the investment over the preferred solution.

7.7 Options summary table

Table 7 sets out a summary of option costs.

Option	CBA whole life NPV	Forecast costs (£)				
		2024	2025	2026	2027	2028
1 Do-Minimum – Replace on failure.	£10.81					[redacted]
2 Planned replacement during RIIO-ED2.	£13.58				[redacted]	
3 Replace with a larger 185 mm² cable.	£12.97				[redacted]	
4 Augmentation with a similar sized cable.	£14.07				[redacted]	
5 Augmentation with a larger cable.	£13.46				[redacted]	
6 Installation of two new cables on the existing route.	£4.56				[redacted]	

Table 7: Summary of option costs

8 Cost Benefit Analysis (CBA)

This section of the report provides an overview of the expected costs for each option from the CBA undertaken and submitted to Ofgem. This represents the output of the detailed exercise undertaken to support the recommended investment strategy and that is now summarised within Appendix 5B – Eriskay-Barra CBA.

8.1 CBA of investment options

The decision to progress with the new cable is supported by CBA. The CBA and wider options assessment demonstrate that replacement now, with an augmented solution, is the best option.

All six options were viable technical solutions and were therefore progressed to the CBA stage. These options are all deemed suitable to meet the long-term CT 2022 DFES out to 2050, under both normal and N-1 conditions.

The CBA considered the eight possible options below:

- Option 1 - Do-Minimum – Replace on failure.
- Option 2 - Planned replacement during RIIO-ED2.
- Option 3 - Replace with a larger 185 mm² cable.
- Option 4 - Augmentation with a similar sized cable.
- Option 5 - Augmentation with a larger cable.
- Option 6 - Installation of two new cables on the existing route.

Table 8 shows the total capex element associated with each of the options which was assessed within the CBA.

CBA Scenario	CAPEX Cost £m (2020/21 prices)					£m (2020/21)
	2024	2025	2026	2027	2028	Total
Option 1					[redacted]	[redacted]
Option 2				[redacted]		[redacted]
Option 3				[redacted]		[redacted]
Option 4				[redacted]		[redacted]
Option 5				[redacted]		[redacted]
Option 6				[redacted]		[redacted]

Table 8: Total CAPEX associated with each CBA scenario

8.2 CBA results

A CBA has been produced utilising the Ofgem standard template. The results of this analysis and the output NPVs can be seen in Table 9Table 9. This analysis has concluded that Option 4 – Augmentation with a similar sized cable, within RIIO-ED2, is the preferred solution based upon NPVs.

This provides the best NPV whilst delivering maximum consumer and network benefits. It also allows SHEPD to maximise the existing asset life whilst protecting the network and associated customers.

Options	NPV after 10 years (£m)	NPV after 45 years (£m)
1. Do-Minimum – replace on failure.	(£3.29m)	£8.02m
2. Planned replacement during RIIO-ED2.	(£2.46m)	£10.67m
3. Replace with a larger 185 mm² cable.	(£2.71m)	£10.07m
4. Augmentation with a similar sized cable.	(£2.42m)	£11.11m
5. Augmentation with a larger cable.	(£2.67m)	£10.51m
6. Installation of two new cables on the existing route.	(£6.55m)	£1.68m

Table 9: Comparison of CBA results for South Uist - Eriskay

9 Deliverability and Risk

SHEPD has existing and well established frameworks in place to allow us to deliver these works as part of business as usual activities. We will soon be looking to establish a new framework for subsea cable installation and may use this project as one of the bidding exercises for possible new framework partners. SHEPD are aiming to create more competition on the new framework to ensure projects are being delivered as efficiently as possible with contract partners requiring to be as competitive as possible to win works.

As a regulated business, SHEPD is required to comply with the Utilities Contracts (Scotland) Regulations 2016 (UCSR) and advertise contracts over the following thresholds:

– Supply, Services and Design Contracts £378,660

– Works Contracts £4,733,252

Call-Off Contracts of an existing framework are not restricted to the above, however consideration has will be given to the framework CPA value. SHEPD may consider widening the procurement event outside of the current framework if more competition is desirable.

SHEPD has delivered a number of projects of this type for a number of years over a number of price controls. There is also a well-established specialist internal subsea cables team who will be managing the surveying, design and installation of this project.

The main risk associated with these works are as follows.

- Possible risk to cost escalation due to several sub risks factors such as
    - Vessel and contractor availability
    - Weather delay
    - Unknown sub bottom profile
    - Unknown route and protection design

SHEPD has no concerns in being able to deliver these works within the RIIO-ED2 price control period.

[redacted].

10 Outlook to 2050

Based on current analysis this solution will be fit for purpose and out to 2050 and beyond. The preferred solution will reduce the probability of failure occurring on this section of network and provides two subsea cables between Eriskay and Barra. Maintaining two subsea cables between the islands alongside the additional whole system works taking place across the Outer Hebrides including the overland solution for South Uist – Eriskay could facilitate the future repurposing, mothballing or removal of Barra Power Station as part of SHEPD's Outer Hebrides whole system solution.

11 Conclusion and Recommendation

It is recommended that SHEPD should be funded for the investment in the Eriskay - Barra subsea cable, with a new augmented subsea cable. This solution is presented as option 4 within this paper and will see the installation of a new 95mm^2 DWA 11kV cable between the islands tying into existing network infrastructure.

This investment will replicate the Eriskay – Barra 2 subsea cable circuit which SHEPD already has installed between the islands. The option has the best NPV from all options in the CBA and will provide a long-term security of supply improvement to the network.

SHEPD has a high confidence in designing, consenting and installing this project within the RIIO-ED2 price control period, which is in the best long-term interest of the network and for customers.

On the basis of this intervention being discrete in the context of its geography and network impacts, and the specification not being driven by wider Outer Hebrides whole system proposals within ED2, we consider that it can assessed separately.

It is proposed that this solution will be designed and consented throughout 2025/26 with installation in 2026/27. The total anticipated costs for this solution are [redacted]. As noted, a portion of these costs are development costs and are covered by HOWSUM Development Funding.

12 References

The documents detailed in Table 10, Table 11 and Table 12 should be used in conjunction with this document.

Table 10: Scottish and Southern Electricity Networks Documents

Reference	Title
N/A	Appendix 5B – Eriskay-Barra CBA
N/A	Hebrides and Orkney Whole System UM Core Narrative
N/A	Appendix 3A – Outer Hebrides 2050 Whole System Proposals EJP (Skye-Uist-Harris)

Table 11: External Documents

Reference	Title
N/A	Distribution Future Energy Scenarios 2022 Results and Methodology Report, North of Scotland licence area, April 2023

Table 12: Miscellaneous Documents

Title

13 Subsequent Sections

14 Revision History

No	Overview of Amendments	Previous Document	Revision	Authorisation
01				
02				

Appendix A Definitions and Abbreviations

Acronym	Definition
ANM	Active Network Management
BAU	Business As Usual
BPS	Barra Power Station
CAPEX	Capital expenditure
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CDM	Construction Design Management
CEM	Common Evaluation Methodology
CI	Criticality Index
CIS	Cable system, Installation and Service
CMZ	Constrained Management Zone
CNAIM	Common Network Assets Indices Methodology
CPA	framework CPA value
CT	Consumer Transformation
DEG	Distributed Embedded Generation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
DSO	Distribution System Operator
DWA	Double Galvanised Steel Wire Armour cable
EHV	Extra high voltage
EJP	Engineering Justification Paper
EoL	End of Life
EPCI	Engineering, Procurement, Construction, and Installation contract
ER P2	Engineering Recommendation P2 Issue 8 2023
FES	Future Energy Scenarios
GB	Great Britain
GSP	Grid Supply Point
HI	Health Index
HOWSUM	Hebrides and Orkney Whole System Uncertainty Mechanism
HV	High Voltage
HVDC	High Voltage Direct Current
kV	kiloVolt
LW	Leading the Way DFES
MVA	Mega Volt Ampere
MW	Megawatt

Acronym	Definition
NPV	Net Present Value
OHL	Overhead Line
OPEX	Operating expenditure
PSS Sincal	Simulation and analysis software for distribution and industrial planning
RIIO-ED1, 2, 3	RIIO Electricity Distribution Price Control periods 1, 2 and 3
ROV	Remotely Operated Vehicle
SBT	Science Based Target
SEPA	Scottish Environment Protection Agency
SEPD	Southern Energy Power Distribution
SHEPD	Scottish Hydro Electric Power Distribution
SWA	Steel Wire Armoured cable
SSEN	Scottish and Southern Electricity Networks
TO	Transmission Operator
UM	Uncertainty Mechanism
UCSR	Utilities Contracts (Scotland) Regulations 2016
WACC	Weighted Average Cost of Capital
XLPE	Cross-Linked Polyethylene Cable