RIIO ED2 Engineering Justification Paper (EJP)

Mainland Orkney – Shapinsay – Asset Replacement

Investment Reference No: 394_SHEPD_SUBSEA_ORKNEY_SHAPINSAY

Contents

Definitions and Abbreviations

Acronym	Definition
EJP	Engineering Justification Paper
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
IDP	Investment Decision Pack
EfW	Energy from Waste
ESA	Electricity Supply Area
EV	Electric Vehicle
FES	Future Energy Scenarios
GIS	Geographic Information System
GW	Gigawatt
kW(h)	kilowatt (hour)
MW	Megawatt
OHL	Overhead Line
PEV	Pure Electric Vehicle
PHEV	Plug-in Hybrid Electric Vehicle
PV	Photovoltaics
BSP	Bulk Supply Point
GSP	Grid Supply Point
LRE	Load Related Expenditure
LCT	Low Carbon Technology
SSEN	Scottish and Southern Electricity Network
UG	Underground Cable

1 Executive Summary

This Engineering Justification Paper (EJP) for Scottish Hydro Electric Power Distribution (SHEPD) covers the investment required to manage the performance of the Mainland Orkney – Shapinsay 33 kV subsea cable which provides supplies to 792 customers fed from Shapinsay, Stronsay and Sanday primary substations. The 33 kV feeder forms part of a 33kV ring circuit around the Orkney Isles.

The ring is formed from a West side and East side with a central open point on the Northern Island of Eday. The East side is formed from Mainland Orkney through Shapinsay, Stronsay and Sanday with the West side from Mainland Orkney through Rousay, Westray and Eday with the open point on Eday at Eday primary substation. The East side is used to back feed the West side in the event of an outage and similarly the West side is used to support the East.

A number of subsea cable circuits have failed during RIIO-ED1, causing significant impact on customer interruptions, constrained generation, and have resulted in impact costs for temporary generation and CO2 emissions. There has been a review of the approach taken to attempt to identify and pre-empt the impact of subsea cable failure by using a 'monetised risk-based approach' alongside a traditional CBRM approach, which was not viewed as identifying the critical circuits for the strategic programme effectively on its own.

The Mainland Orkney – Shapinsay subsea cable is 27 years old and has a current Health Index of HI5 and C2 Criticality rating.

Following optioneering and detailed analysis, as set out in this paper, the proposed scope of works for the existing Mainland Orkney - Shapinsay circuit are as follows:

- Replace the Mainland Orkney - Shapinsay 33 kV subsea cable by laying a [redacted] km 185mm² (24 MVA) cable replacing the existing 70mm² (14.3MVA) cable.

The anticipated cost to deliver the preferred solution is £[redacted]. The delivery programme for all subsea cables in ED2 will be determined through detailed planning and engagement with marine installation contractors and cable procurement opportunities. For simplicity, where required, the delivery year is assumed as 2024/25 in this EJP and this will be refined as our programme develops.

This scheme delivers the following outputs and benefits:

- Improves reliability, reducing potential of customer interruptions
- Reduces the risk of constrained generation.
- Reduces the monetised risk, which is forecast to be £403,002 by the end of ED2 with no intervention, to £39,307.

Option 3, replacement with a larger sized cable was selected as the preferred option given the anticipated load / generation growth on the circuit.

All subsea cable EJPs should be read in conjunction with the ***Scottish Islands (Annex 8.1)*** of our RIIO-ED2 Business Plan.

2 Investment Summary Table

Table 1 below provides a high-level summary of the key information relevant to this Engineering Justification Paper (EJP).

Table 1: Investment Summary

Name of Programme	Mainland Orkney – Shapinsay Asset Replacement		
Primary Investment Driver	The Primary Investment Driver described within this EJP is the requirement to reduce the overall monetised risk associated with the loss of the existing subsea cable from Mainland Orkney to Shapinsay.		
Investment reference/mechanism or category	Cost Benefit Analysis reference: 394_SHEPD_SUBSEA_ORKNEY_SHAPINSAY		
Output reference/type	As above		
Cost (£m)	£[redacted]		
Delivery year	ED2 (2024/25)		
Reporting Table	CV7: Asset Replacement		
Outputs included in RIIO-ED1 Business Plan	Yes – Deferred due to requirement to deliver high number of fault projects.		
CV7 Asset Replacement RIIO ED2 Spend (£m)	**Asset Category**	**ED2 (£m)**	**Total (£m)**
	EHV Subsea Cable	[redacted]	[redacted]

3 Introduction

This Engineering Justification Paper (EJP) for Scottish Hydro Electric Power Distribution (SHEPD) covers the investment required to manage the performance of the Mainland Orkney - Shapinsay 33 kV subsea cable which provides supplies to 792 customers, under normal operation, on the islands of Shapinsay, Stronsay and Sanday primary substations.

The Primary Investment Driver described within this EJP is based on reducing the overall monetised risk associated with this circuit which has been determined from the "Strategic Subsea Cable CBA Model" developed to determine the overall replacement / augmentaiton strategy for all subsea cables by mitigating the monetised risk associated with the subsea cable assets. The model evaluates the probabilty of failure, the cost of intervention and the impact cost and used this assesment across the asset population to determine the initial investment method to be considered. Further detail on the Strategic Subsea Cable CBA Model is provided in the ***Scottish Islands (Annex 8.1).***

This cable forms part of a 33kV ring around a number of the Orkney Isles in conjunction with a 33kV circuit from Mainland Orkney through Rousay which supplies a further 1,517 customers, Figure 1 (Orkney Shapinsay feeder highlighted). The network open point is situated at Eday Primary substation. Eday is supplied from the Western side of the 33kV ring.

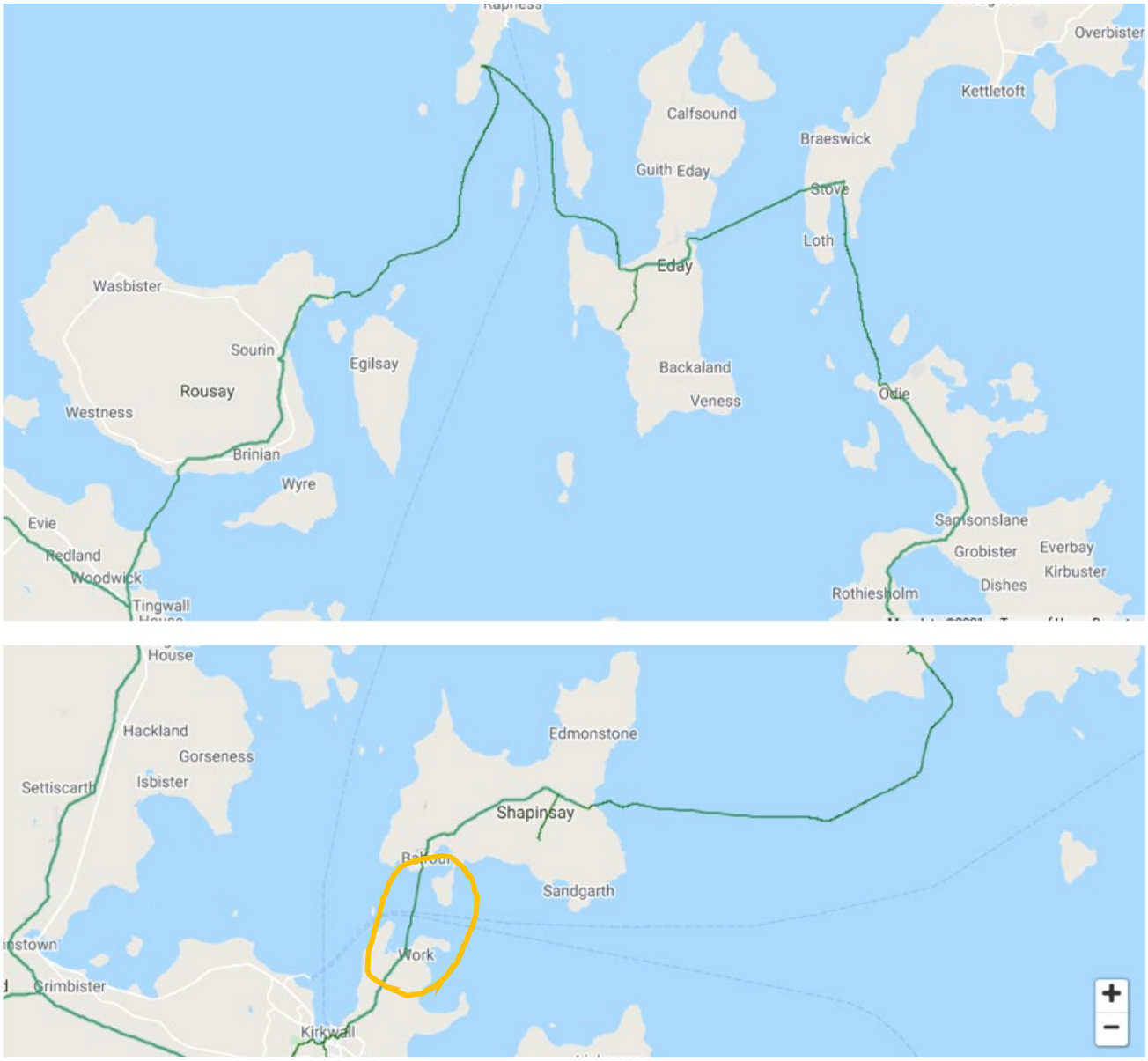


Figure 1 Mainland Orkney - Shapinsay 33 kV Feeder

The Mainland Orkney - Shapinsay 33 kV subsea cable is 27 years old, supplies 792 customers, and has 8.4 MW of connected generation which is constrained when the supply is interrupted. This cable is also a strategic back feed circuit for demand customers as part of the Orkney 33kV ring. During fault assessments it is possible to see if any additional generation can be re-routed around the back feed circuit. The existing cable is HI5 and C2 criticality. The benefit of replacement reduces the Probability of Failure, within the CNAIM model. Currently the cable has a PoF of 0.092 which is forecast to increase to 0.321 by the end of ED2, should no intervention take place. The PoF will be reduced to 0.0313 after intervention. The monetised risk associated with this cable is currently £115,432 and would increase to £403,002 by the end of ED2 with no intervention, the monetised risk will reduce to £39,307 after replacement.

Section 4 provides high-level background information for this subsea asset category and explains the importance of this asset for our electricity distribution network and our network customers, and the motivation for ensuring our subsea cables are in good health over the course of RIIO-ED2 and beyond.

Sections 5 and 6 provide a summary of the corresponding intervention options which can be deployed as a solution to these condition related investment drivers.

Section 7 provides a detailed analysis then describes the cost and volumes arising from the preferred intervention options as supported by the Cost Benefit Analysis (CBA) results which complements this EJP.

Section 8 provides an overview of the deliverability and risk management considerations being adopted for the transition from RIIO-ED1 in to RIIO-ED2, and the delivery of subsea cable asset replacement projects.

Section 9 provides an overview of the information presented throughout the EJP and concludes a proposed solution recommended to manage the business case presented.

4 Background Information and Analysis

4.1 How Do We Determine Our Intervention Priorities

We introduced our Condition Based Risk Management (CBRM) system in 2014 following the RIIO-ED1 Business Plan submission. However, since August 2017, we switched over fully to maximise utilisation of the Common Network Assets Indices Methodology (CNAIM) modelling for all asset classifications applicable for the RIIO-ED1 requirements with the data inputs outlined in the Information Gathering Plan (IGP).

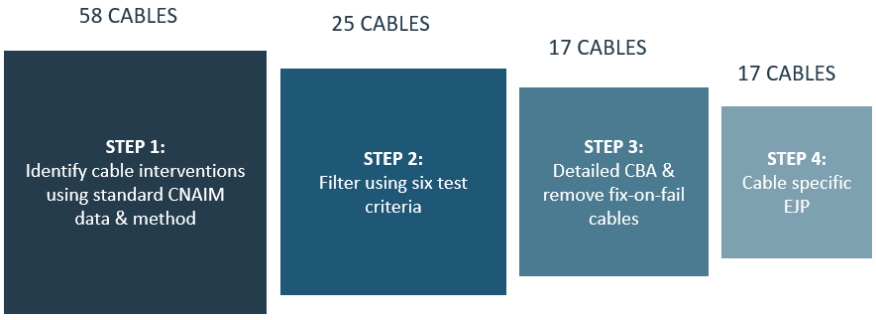
The RIIO-ED2 Business Plan submission has been based on the latest version of the industry standard CNAIM v2.1 which was approved for use in RIIO-ED2 by Ofgem in April 2021. The supporting data used in the modelling of this submission is based on the reported position of our asset condition for RIIO-ED1 Year 6 at the end of August 2021.

The full details of the Energy Network Association's NARMs Electricity Distribution Working Group (NEDWG) publication on CNAIM v2.1 is available on Ofgem's website. For further detail on our RIIO-ED2 NARMS strategy please see ***Safe and Resilient (Annex 7.1).***

Our proposed investment programme in ED2 is asset data led; refined and iterated by overlaying the industry standard risk management methodology with enhanced risk modelling and cable specific cost benefit analysis. We are proposing planned replacement of cables where the certainty of need is highest driven by high probability and impact of failure in ED2.

We have adopted a four-step funnel approach, as shown below, to determine the interventions required on the network. This approach allows us to filter from an initial examination of the complete list of subsea cables we operate to a credible and deliverable list of interventions which are supported by robust analysis. Steps 1 to 3 are set out in detail within our ***Scottish Islands (Annex 8.1).***

This EJP covers Step 4 for the Mainland Orkney - Shapinsay cable which has qualified as requiring intervention. We set out here our approach to clearly justify why the circuit design approach is being proposed and associated costs are the most economic and efficient, and what work would be required to deliver on these investments.



4.2 Existing Network Arrangement

The existing 33kV network configuration is shown in Figure 2 with the subsea crossings to Shapinsay and to Rousay from the mainland highlighted in yellow.

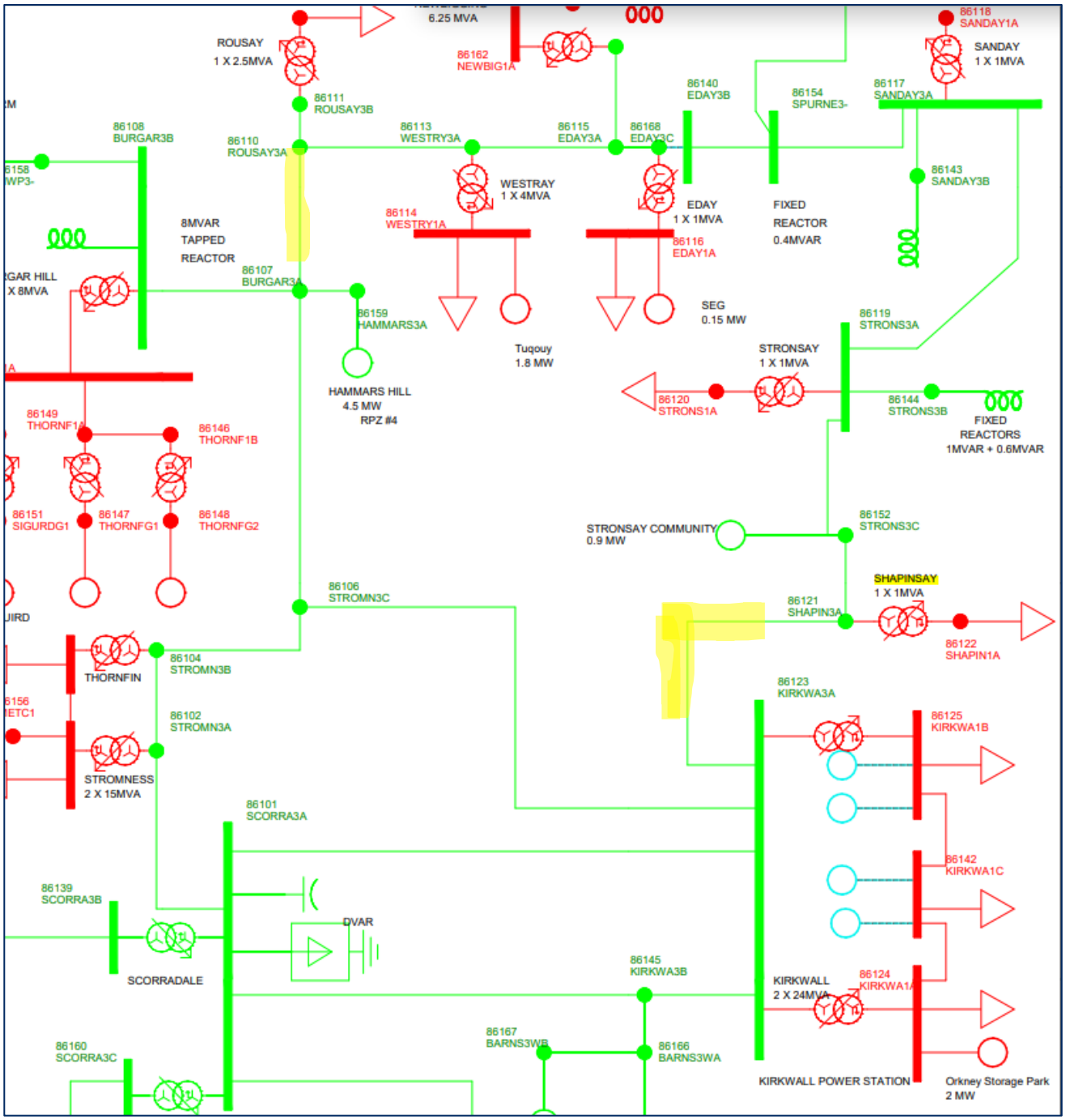


Figure 2 Mainland Orkney – Shapinsay 33 kV network

The Mainland Orkney – Shapinsay subsea cable is a 70 mm²EPR SWA Prysmian cable rated at 14.3 MVA. The geographic route is shown in Figure 3 with the Mainland Orkney-Shapinsay 33 kV feeder running from Kirkwall Primary.

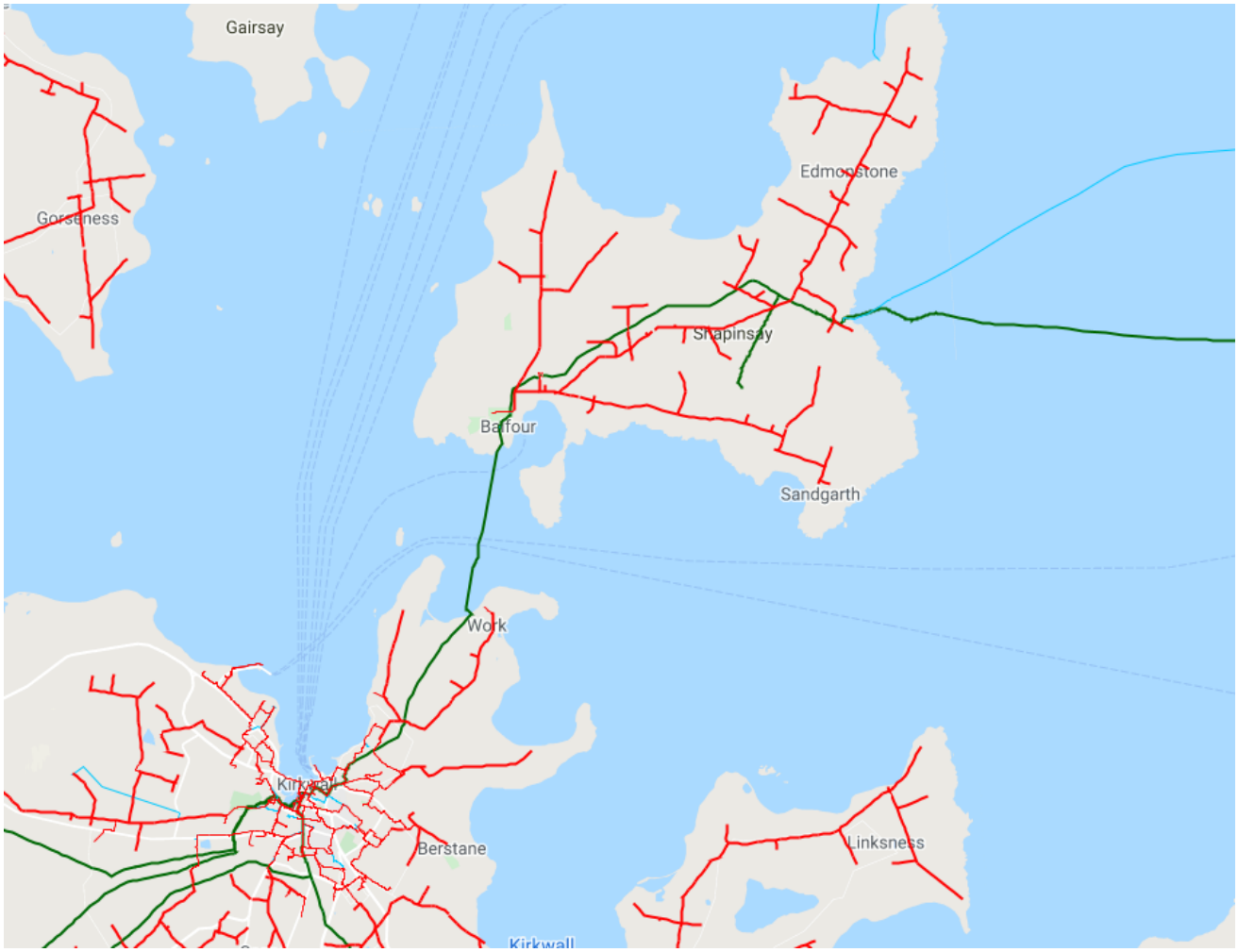


Figure 3 Mainland Orkney – Shapinsay 33 kV subsea cable

4.3 Existing Asset Condition

The Common Network Asset Indices Methodology (CNAIM) models maintained by SSEN 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 Mainland Orkney – Shapinsay 33 kV feeder is 2.9 km and has been in service 27 years. Surveys have designated the cable an HI5 and is C2 criticality. The current PoF is 0.092, which is expected to rise to 0.321 at the end of ED2 with no intervention.

4.4 Demand & Generation Forecast

The Mainland Orkney – Shapinsay 33kV cable is currently loaded to 5.68 MVA. The cable is a 33 kV 70 mm² EPR SWA Prysmian cable and rated at 14.3 MVA. The demand projection is shown in Figure 4.

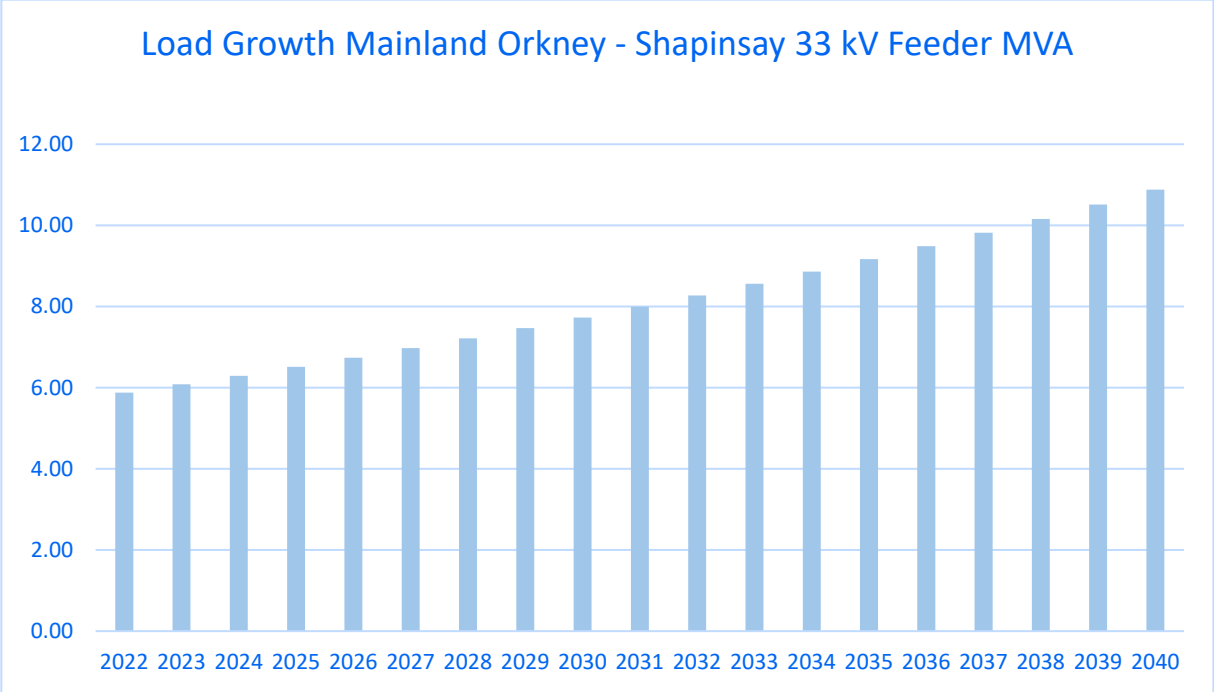


Figure 4 Load Forecast on Mainland Orkney – Shapinsay 33 kV Feeder

The load forecast for the Mainland Orkney - Shapinsay 33 kV feeder, is 3.48%, and forecast demand at the end of ED2 is expected to be 7.2 MVA (51% of the cable rating). The Mainland Orkney - Rousay 33 kV feeder forms the other part of the ring and has 1,517 customers and also has a maximum demand of 5.68 MVA. This feeder is a 185 mm² (24MVA) cable.

The 33 kV ring ensures supplies are maintained following an interruption, however the 8.4MW of generation is constrained. Demand growth is not considered a significant factor in this area, but detailed load flow analysis will be conducted at the design engineering phase to determine that cable capacity is suitable over the predicted life of the asset taking into account DFES forecasting. In this area, the largest factor is generally generation. Studies will also be undertaken to assess cable suitability for current and future generation on the Orkney isles and look to future proof this investment given pushes for net zero and green technology. It should be noted there is likely to be a requirement to upgrade substantial amounts of onshore network to release any significant additional generation capacity over the whole Orkney Isles Group of the distribution network, although the subsea cable inter island links will play a significant part of that infrastructure.

5 Summary of Options Considered

This section of the report sets out the investment options that have been considered for intervention on the existing cable. The approach taken has been to ensure investment options demonstrate best value for money for network customers.

5.1 Summary of Options

Table below provides a high-level summary of the six (6) investment options that have been considered along with the advantages and disadvantages associated with each. A more detailed description of each option is then provided within the following sub-sections.

Table 5: Summary of Primary Investment Options

Option	Description	Advantages	Disadvantages	Results
1. Do Minimum	Replace on failure	Low initial cost	Availability of material and resource when required. High cost of repair where practical with unknown resolution of the fault and not viable for short cables	Rejected
2. Replace	Replace the cable with the same size cable on the same route	Improves HI. Provides new life cycle and allows reduced probability of failure	Improves the reliability with the new circuit, but limits the capability for this circuit to provide back up for the ring in the future	Rejected
3. Replace with larger cable	Replace the cable with a larger cable on the same route	Improves HI. Provides new life cycle. Provides for future load and generation growth. Future proof the 33kV ring network. Bring in-line with other subsea cable sizes on the ring.	No significant disadvantages, slightly higher initial cost	Recommended option
4. Augmentation	Lay a new cable and retain the old cable connecting new cable into the 33 kV primaries.	Provides enhanced security for the ring but only into Shapinsay with the other island supplies via longer higher risk subsea cables, so limited benefit	The higher cost only improves security of supply to Shapinsay not the other islands on the ring, and only till the existing cable fails	Rejected
5. Augmentation larger cable	As option 4 but providing enhanced capacity in the section from Mainland Orkney to Shapinsay	Provides enhanced security for the ring but only into Shapinsay with the other island supplies via longer higher risk subsea cables, so limited benefit. Bring cable in-line with other subsea cable sizes on the ring.	Improves the security with two cables in commission. However, would fall back to single circuit following the failure of the existing circuit. And the cost increase not justified	Rejected

6. Two new cables existing route	Lay two new cables along the known route of the existing cable and provide enhanced security of supply to Shapinsay	Provides enhanced security of supply and removes the impact of a failure for a single circuit, increasing reliability	Much higher cost	Rejected

It should be noted that a Horizontal Directional Drilling (HDD) solution has previously been considered, with a feasibility study specifically conducted in this area. The HDD solution was deemed not practicable or cost efficient, and therefore this option has not been considered within the EJP or CBA.

6 Analysis and Cost

The details of each option are described below:

6.1 Option 1: Do-Minimum replace on failure

The "Do Minimum" Option is for the repair or replacement of the cable on failure. Based on the age, health index and length of the cable, repair would be by replacement of the entire subsea section of the cable following a similar route to that of the existing cable shown previously.

The total anticipated cost with this option is based on planned replacement costs uplifted by [redacted] % to reflect the premium which is paid when conducting a replacement under an emergency situation. This gives a total anticipated cost for this option of £[redacted]. This additional [redacted] % premium is added due to the cost when the replacement is done under emergency conditions without sufficient time to plan and procure the replacement in an efficient manner. This provides for an equivalent size cable (95mm²) to provide capacity of 14 MVA which would satisfy the demand forecast beyond 2040. The circuit however is part of a 33 kV ring around Shapinsay, Stronsay, Sanday, Eday, Westray and Rousay which utilises the feeder for back up to for 1,517 customers and a further 6 MW of generation. This option would incur the constrained generation costs.

Costs incurred would be the following

- Constrained generation £1.23 m
- Capital cost £[redacted] m
- Impact cost £0.02m

This option avoids any initial cost of intervention and, should the cable not fault over the next price control, will defer expenditure beyond ED2. However, the cable is classed as HI5 and C2, and the cost of an emergency replacement would be higher than a planned replacement if the cable fails and it incurs the additional impact cost and constrained generation cost.

This option has been rejected, as it would incur impact cost, constrained generation cost and reputational damage. The replacement cost in an emergency is anticipated to be around [redacted] % higher than a planned replacement cost.

6.2 Option 2: Replace the cable with the same size cable 95 mm²

Replacing the cable with a new 95mm², subsea cable would be the lowest capital cost solution and will improve the Health Index and Probability of Failure resulting in a change to the characteristics set by the age (27 years) and condition (HI5). The new cable would be connected to the existing network points on Mainland Orkney and Shapinsay, and the old cable disconnected. The demand on the cable is 5.7 MVA with a load growth forecasting of 3.48%, a rise to 10.9 MVA by 2040, however the alternate side of the ring is forecast to see load growth of 5.53% taking the demand on the Mainland Orkney - Rousay to 15.8MVA. This could limit the ability of this feeder to support demand in the event of a fault.

The initial anticipated capital cost would be £[redacted].

There would be no impact cost or constrained generation cost and this is the least capital cost option.

The Probability of Failure would increase from current 0.092 to 0.321 in ED2 without intervention, reducing to 0.0313 with replacement.

This option was rejected as it does not provide sufficient capacity for the demand and generation on the 33 kV ring from Mainland Orkney through Shapinsay and Rousay.

6.3 Option 3: Replace with a larger 185 mm² cable

This option involves laying a 185 mm² (24 MVA) subsea cable rather than the like for like replacement in option 2. This cable has a higher initial cost. The advantage this has over option 2 is that it would cater for growth beyond 2040 and provide capacity to support the Mainland Orkney - Rousay feeder, but at higher initial cost.

The anticipated capital cost of this option would be £[redacted].

This was selected as the preferred option due to the additional capacity.

6.4 Option 4: Augmentation with a similar sized cable.

This option is similar to option 2, laying a similar cable to the existing 95mm², but retaining the existing cable until it fails. This would incur additional costs for connection into the 33 kV network on Mainland Orkney and Shapinsay.

This would provide enhanced security with two circuits to Shapinsay until the existing cable failed, at which time the supply would revert to a single circuit as in option 2. The existing circuit is 27 years old and has an HI5 condition score, therefore the cable is unlikely to provide the benefit for many years.

The existing cable would continue to operate until it develops a fault, at which point there would be another evaluation as to the possible options for that cable, however at the time of the fault the supplies would still be maintained through the new cable.

The anticipated cost of this option is as option 2 plus the added cost of connection into the network.

The anticipated cost of this option is £[redacted].

This option was rejected as it would not provide sufficient capacity to support the demand and generation on the 33 kV ring in the longer term, and additional expenditure would be required. The HI5 condition score also suggests that the existing cable may become faulty within ED2 and the expense of the additional land based costs would be redundant.

6.5 Option 5: Augmentation with a larger cable.

This option is similar to option 4 but utilising a 185mm² cable instead of the 95mm².

This would cater for any potential growth beyond 2040 and support the 33 kV feed from Orkney to Rousay. This, like option 4, provides N-1 security of the short [redacted] km subsea cable onto Shapinsay but not over the longer subsea sections through the other Islands. The health of the existing cable is also of concern and the costs incurred on the land based connections may be redundant within ED2.

The anticipated cost of this option would be £[redacted].

This option was rejected due to the higher capital cost over option 3.

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

This 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 on the Mainland Orkney - Shapinsay route without relying on the Mainland Orkney - Rousay back up 33 kV feeder. This would also avoid any constraint on generation. The laying of the two new cables together under the same contract is expected to allow cost saving of 15% on the second cable compared to the first.

This has been estimated on 95 mm² cables and would provide duplicate supplies onto Shapinsay direct from Mainland Orkney while retaining the Rousay alternative 33 kV backup feeder.

The overall anticipated cost of this option was £[redacted].

This option was rejected as although there were technical benefits over options 1-5, there was a significantly higher initial capital cost which are deemed unnecessary at this time given there is an alternative supply in place via the Mainland - Rousay cable.

7 Summary of Cost Benefit Analysis (CBA)

This section of the report provides an overview for each option from the Cost Benefit Analysis (CBA). A detailed exercise has been undertaken to support the investment strategy that is described within this EJP for the 6 options, as described below:

7.1 Summary of Costs

Our RIIO-ED2 Business Plan costs are derived from our outturn RIIO-ED1 expenditure. For our Subsea cable projects, our Unit Costs have been derived from analysing costs pertaining to delivered projects completed during RIIO-ED1 and are therefore based on actual costs. For cable installation activities the delivered projects were competitively tendered utilising our Subsea Cable Installation Framework and cable costs have been benchmarked against recently completed tender events. By tying our costs back to reported, outturn, real life data this approach provides multiple data points and provides a high level of cost confidence in our Business Plan cost forecast for RIIO-ED2.

As our Business Plan has developed, project scopes and costs have been refined, especially with the input of valuable stakeholder feedback on our draft proposals. This final Business Plan submission cost forecast contains that refinement, and the changes are captured within our supporting plan documentation. The generic Unit Cost rates used in the draft Business Plan have now been revised following extensive analysis. This is further defined within ***Scottish Islands (Annex 8.1).***

The 6 options considered were costed to determine the capital costs incurred and the year of investment. The cost to implement each option and the year when the investment is expected is indicated in the table below.

Table 6: Summary of Capital Costs

Options	Unit	2023/24	2024/25	2025/26	2026/27	2027/28	Total
1. Do Minimum	£m	0	0	0	0	[redacted]	[redacted]
2. Replace	£m	0	[redacted]	0	0	0	[redacted]
3. Replace with larger cable	£m	0	[redacted]	0	0	0	[redacted]
4. Augmentation	£m	0	[redacted]	0	0	0	[redacted]
5. Augmentation larger cable	£m	0	[redacted]	0	0	0	[redacted]
6. Two new cables existing route	£m	0	[redacted]	0	0	0	[redacted]

7.2 Cost Benefit Analysis Comparisons

Although there is little difference between options 2 to 5, option 3 provides the best technical solution for future load growth on the 33 kV ring.

Table 7: CBA Comparison

Options	NPV After 45 Years (£m)
Option 1 – Do Minimum	[redacted]
Option 2 – Replace	[redacted]
Option 3 – Replace Larger Cable	[redacted]
Option 4 – Augment	[redacted]
Option 5 – Augment Larger Cable	[redacted]
Option 6 – Replace Two New Cables Along Existing Route	[redacted]

The monetised risk value for the Mainland Orkney to Shapinsay 33 kV subsea cable is currently £115,432 and without intervention will increase to £403,002 at the end of ED2. With the intervention proposed in this EJP the monetised risk value will reduce to £39,307.

7.3 Volume on Preferred Option

The option selected requires a new cable to be laid along the existing cable route and connected into the current 33 kV network.

Table 8: Asset Volumes

Asset Category	Unit	2023/24	2024/25	2025/26	2026/27	2027/28	Total
33kV Subsea Cable	km	0	[redacted]	0	0	0	[redacted]

8 Deliverability & Risk

Our ***Deliverability Strategy (Annex 16.1)*** describes our approach to evidencing the deliverability of our overall plan as a package, and its individual components. Testing of our EJPs has prioritised assessment of efficiency and capacity, and this has ensured that we can demonstrate a credible plan to move from SSEN's RIIO-ED1 performance to our target RIIO-ED2 efficiency.

We have also demonstrated that SSEN's in house and contractor options can, or will through investment or managed change, provide the capacity and skills at the right time, in the right locations. This assessment has been part of the regular assessment of our EJPs, IDPs and BPDTs. For the investment proposed under our subsea cable related EJPs, we have been developing our RIIO-ED2 Commercial & Deliverability Strategy and engaging with our supply chain to ensure we can deliver the solutions proposed, while identifying and managing the risks presented by the complex and challenging nature of the projects.

Our deliverability testing has identified major strategic opportunities which is relevant to all subsea EJPs.

- In RIIO-ED2, SSEN will change the way Capital Expenditure is delivered, maximising synergies within the network to minimise disruptions for our customers. This is particularly relevant for a Price Control period where volumes of work are increasing across all work types.
- The principle is to develop and deliver programmes of work, manage risk and complexity at programme level and to develop strategic relationships with our suppliers and partners to enable efficiency realisation. This potentially includes refining our contracting strategies to improve our risk profiles.
- Transparency with the supplier in terms of constraints, challenges, outage planning and engineering standards will capitalise on efficiencies, supported by a robust contracting strategy.

The delivery programme for all subsea cables in RIIO-ED2 will be determined through detailed planning and engagement with marine installation contractors and cable procurement opportunities. In addition, early stakeholder engagement will significantly de-risk project schedules and deliver value.

We are already identifying opportunities for improved efficiency and improved risk management of our projects and associated programmes. As part of the planning for our final Business Plan submission, we have explored subsea cable project 'bundling' by cable type and geographic location. Our delivery year for each EJP is based on this initial assessment, which will be further explored and then refined with our supply chain in early 2022 to identify the optimal equilibrium of project deliverability and risk management.

This subsea cable project was originally included in our baseline for delivery during the RIIO-ED1 period, made up of a number of projects. However, due to the unforeseen network requirement to replace other subsea cables or sections of cable that had failed or had an unexpectedly higher probability of failure, this individual scheme has been deferred into RIIO-ED2. These unforeseen events have resulted in the requirement to efficiently prioritise the spend of allowances on the replacement of subsea cables based on customer impact size and distributed generation in RIIO-ED1, or to rectify cable faults to ensure a secure supply of power to our island communities.

9 Conclusion

The purpose of this Engineering Justification Paper (EJP) has been to provide the investment justification and option selection for the 33 kV subsea cable from Mainland Orkney to Shapinsay.

Due to the number of subsea cable faults in RIIO-ED1, including the Pentland Firth East Cable, the approach taken for EIIO-ED2 has been to pre-empt failures where possible. The creation of the monetised risk CBA model allows for the circuits which are likely to have the biggest impact, should a failure occur, to be addressed. This approach considers the subsea population within the generic CBA model to help identify the appropriate circuits to be replaced.

The monetised risk value for the Mainland Orkney to Shapinsay 33 kV subsea cable is currently £115,432 and without intervention will increase to £403,002 at the end of ED2.

Six options were considered as shown:

- Option 1: Do Minimum – replace on failure
- Option 2: Replace the cable with the same size cable
- Option 3: Replace the cable with a larger cable
- Option 4: Augment by laying a similar sized cable and retaining the existing cable.
- Option 5: Augment by laying a larger cable and retaining the existing cable.
- Option 6: Lay two new cables along the existing route

Option 3, replace the cable with a larger cable, at a cost of £[redacted] has been selected as the preferred solution. The NPV for option 3 was £3.18m, the third best NPV, but provides better capacity for the future growth at lowest cost and maintains the ability to back feed the rest of the Orkney ring in the future. With the intervention proposed in this EJP the monetised risk value will reduce £39,307.

CV7 Asset Replacement	Asset Category	ED2
CV7 RIIO ED2 Spend (£m)	EHV Subsea Cable	[redacted]