RIIO-ED2 Engineering Justification Paper (EJP)

Skulamus Primary Substation P2 Compliance Reinforcements

Investment Reference No: 79/SHEPD/LRE/SKULAMUS

Contents

Definitions and Abbreviations

Acronym	Definition
AIS	Air-insulated Switchgear
ASCR	Aluminium Conductor Steel Reinforced
BSP	Bulk Supply Point
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CEM	Common Evaluation Methodology
CI	Customer Interruptions
CML	Customer Minutes Lost
CT	Consumer Transformation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
EJP	Engineering Justification Paper
ESA	Electricity Supply Area
EV	Electric Vehicle
FCO	First Circuit Outage
FES	Future Energy Scenarios
GIS	Geographic Information System
GM	Ground Mounted
GSP	Grid Supply Point
HI	Health Index
IDP	Investment Decision Pack
LCT	Low Carbon Technology
LEP	Local Enterprise Partnership
LI	Load Index
LRE	Load Related Expenditure
LW	Leading the Way
NPV	Net Present Value
OHL	Overhead Line
PM	Pole Mounted
PV	Photovoltaics
RSN	Relevant Section of Network
SCO	Second Circuit Outage
SSEN	Scottish and Southern Electricity Network
SP	Steady Progression
ST	System Transformation
XLPE	Cross-linked Polyethylene

1 Executive Summary

This proposed investment will deliver load related investment of £2.17m during the RIIO-ED2 price control at Skulamus primary substation.

The primary investment driver for this scheme is load, specifically an ER P2 compliance issue at Skulamus primary substation. This load related issue is apparent under all four of SHEPD's Distribution Future Energy Scenario (DFES) scenarios and investment is required to provide sufficient capacity in order to progress towards net zero, improve the security of supply standard and facilitate renewable generation and the uptake of low carbon technologies (LCT) such as EVs and Heat Pumps in the Highland area.

Highland council is currently working in line with Scottish Government targets to target a low carbon Highlands and a carbon neutral Inverness by 2025. SHEPD has considered the views and targets of the council through various DFES stakeholder engagement activities.

Skulamus Primary substation is currently derogated from P2/7 under the SHEPD standards of voltage and security of supply[1]. However, given Highland Councils's own ambitious progression towards Net Zero and the increasing demand on the distribution network, SHEPD believe that rectifying the P2/7 non-compliance is the most appropriate action moving into RIIO-ED2. Without intervention on this scheme, it is expected that existing and future demand on Skulamus Primary would remain without appropriate backfeeding arrangements which may prove a barrier for Net Zero targets with the substation remaining non-compliant with P2.

The EJP considers an exhaustive range of options to address the P2/7 compliance issues, setting out the options that have been considered and rejected prior to the CBA analysis along with clear rationale for including or excluding each option.

The Cost Benefit Analysis results shown below in table 1 demonstrates that the most cost-effective solution, that delivers the best value for consumers in terms of the 45 years Net Present Value (£m), is option 2 which will installs additional assets onto the network.

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2 – Establish New Lussa Primary Substation & 11kV OHL (Preferred Option)	-1,855	2,169
Option 3 – Additional Transformer & New 11kV OHL	-2,065	2,425

Table 1: Option Summary

Our CBA quantifies the benefits associated with each option to support our assessment. For this investment scheme the societal benefits are predominantly attributed to avoided losses and the associated reduction in CO_2. For our preferred option 2, the monetary associated benefit is £0.22m over the 45-year period.

Our load related investments contribute very minor CI and CML benefits, as result of their low counterfactual health indices and our licence obligations around overloading of the network. A more detailed explanation can be found in our ***Cost Benefit Analysis Process (Annex 15.8)***.

[1] SHEPD "Distribution Planning: Standards of Voltage and Security of Supply" (P0-PS-037)

Following the optioneering and detailed analysis, as set out in this paper, the proposed scope of works for Option 2 is:

Asset	Volume	Costs
33kV UG Cable (Non-Pressurised) (km)	0.2	[redacted]
33kV Transformer (GM)	1	[redacted]
33kV CB (Gas Insulated Busbars)(ID)(GM)	3	[redacted]
6.6/11kV OHL (Conventional Conductor) (km)	21	[redacted]
6.6/11kV Poles (No.)	240	[redacted]
6.6/11kV CB (GM) Primary	3	[redacted]
6.6/11kV Switch (PM)	1	[redacted]
6.6/11kV Transformer (GM)	1	[redacted]
Total		**£2,169k**

Table 2: Investment Summary

This scheme delivers the following outputs and benefits:

- Provides security of supply levels at Skulamus primary substation which comply with P2/7.
- Facilitate the continued uptake of low carbon technology (LCT) with the Skulamus area and help support the climate change targets of Highland Council.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

The cost to deliver the preferred solution is £2.17m and the works are planned to be completed in 2028. This EJP investment sits within our Net Zero Totex ask.

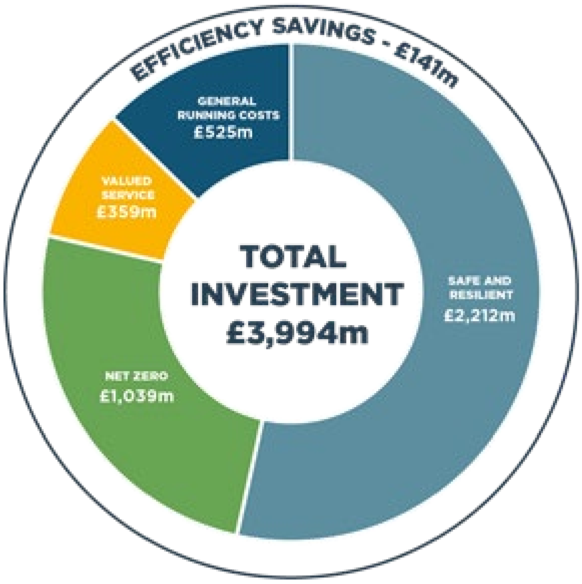

Figure 1: SSEN total investment cost within RIIO ED2

2 Investment Summary Table

The table below provides a high-level summary of this Engineering Justification Paper (EJP) and the Cost and Volume (CV) impacts within SSEN's Business Plan Data Templates.

<table>
<tr><td>Name of Scheme</td><td colspan="3">Skulamus Primary Substation P2 Compliance Reinforcements</td></tr>
<tr><td>Primary Investment Driver</td><td colspan="3">Load – P2/7 Compliance</td></tr>
<tr><td>Scheme reference</td><td colspan="3">79/SHEPD/LRE/SKULAMUS</td></tr>
<tr><td>Output reference/type</td><td colspan="3">33kV UG Cable (Non-Pressurised)
33kV CB (Gas Insulated Busbars)(ID)(GM)
33kV Transformer (GM)
6.6/11kV Transformer (GM)
6.6/11kV CB (GM) Primary
6.6/11kV Switch (PM)
6.6/11kV OHL (Conventional Conductor)
6.6/11kV Poles</td></tr>
<tr><td>Cost</td><td colspan="3">£2.17m</td></tr>
<tr><td>Delivery year</td><td colspan="3">2027/28</td></tr>
<tr><td>Reporting Table</td><td colspan="3">CV1: Primary Reinforcement</td></tr>
<tr><td>Outputs included in RIIO ED1 Business Plan</td><td colspan="3">No</td></tr>
<tr><td rowspan="2">Spend apportionment</td><td>ED1</td><td>ED2</td><td>ED3+</td></tr>
<tr><td>0</td><td>£2.17m</td><td>0</td></tr>
</table>

Table 3: Investment Summary

3 Introduction

Our ***Load Related Plan Build and Strategy (Annex 10.1)***[2] sets out our methodology for assessing load-related expenditure and describes how we use the Distribution Future Energy Scenarios (DFES) 2020 as the basis for our proposals. We have established a baseline view of demand, providing a robust projection of the drivers of load-related expenditure for the ED2 period. Our ex-ante baseline funding request is based on the minimum investment required under all credible scenarios and is strongly supported by our stakeholders. Our plan will create smart, flexible, local energy networks that facilitate the accelerated progress towards net zero – with an increased focus on collaboration and whole-systems approaches.

This investment is a component of our strategic goal of 'Accelerating progress towards a net zero world'.

Section 4 of this Engineering Justification Paper (EJP) describes our proposed load related investment plan for the reinforcement of Skulamus Primary Substation in RIIO-ED2. The primary driver considered within this paper is load related P2/7 compliance issues under existing demand which are worsened by forecast demand growth from our stakeholder supported Distribution Future Energy Scenario (DFES).

This EJP provides high-level background information for this proposed scheme explaining the existing network arrangements, the load growth forecasts through the Distribution Future Energy Scenarios (DFES) and setting out the need for this project. The Detailed Analysis section of the EJP describes the network studies undertaken, detailing the results which further justify the need of the proposed investment.

Section 5 provides an exhaustive list of the options considered through the optioneering process to establish the most economic and efficient solution. Each option is described in detail, with the EJP setting out the justification for those options which are deemed unviable solutions, and therefore not taken forward to the Cost Benefit Analysis.

Section 6, Cost Benefit Analysis (CBA) Summary, provides the comparative results of all the options considered within the CBA and sets out the rationale and justification for the preferred solution. This section also describes how we have established the cost efficiency of the plan with reference to the unit costs that have been chosen.

Finally, **Section 7** of this EJP also sets out the deliverability of the plan for RIIO-ED2 and this proposed investment.

4 Background Information and Analysis

4.1 Existing Network Arrangement

Broadford GSP, which feeds Skulamus Primary, is located within the Highlands area of Scotland is supplied via 1 x 30MVA 132kV/33kV transformer. Skulamus is supplied by Broadford GSP via a single 33kV tee-off connection on the Broadford – Kyle 33kV circuit. The Broadford – Kyle 33kV circuit is interconnected with Grudie Bridge GSP.

The 33/11 kV primary transformer at Skulamus is rated at 6.3MVA and was installed in 2016 as a replacement for the previous 4 MVA unit which was susceptible to transformer capacity exceeded by the demand under max load/backfeeding arrangements. The existing 33kV and 11kV network arrangement is shown in Figure 2.

Skulamus primary has 3 no. 11kV feeders: 011, 012 and 013. Feeder 011 is normally opened at the 11kV feeder breaker and interconnects with the Broadford 11 kV feeder circuit. Feeder 012 supplies the south and east of

[2] ***SECTION D: (Chapter 10), Responding to the net zero Opportunity, (Annex 10.1), Load Related Plan Build and Strategy***

Skye with the most remote spurs terminating at Kyleakin and Kylerhea. Feeder 012 is afforded interconnection with Broadford close to Skulamus primary but has no interconnection at the remote end. At Kyleakin the feeder is within 1.5km of Kyle primary, albeit separated by Loch Alsh. Feeder 013 is a radial feeder which serves the Sleat Peninsula; its two most remote terminal points at Ord and Aird of Sleat are roughly 30km away from the source substation. The feeder is not afforded any interconnection with other 11kV circuits.

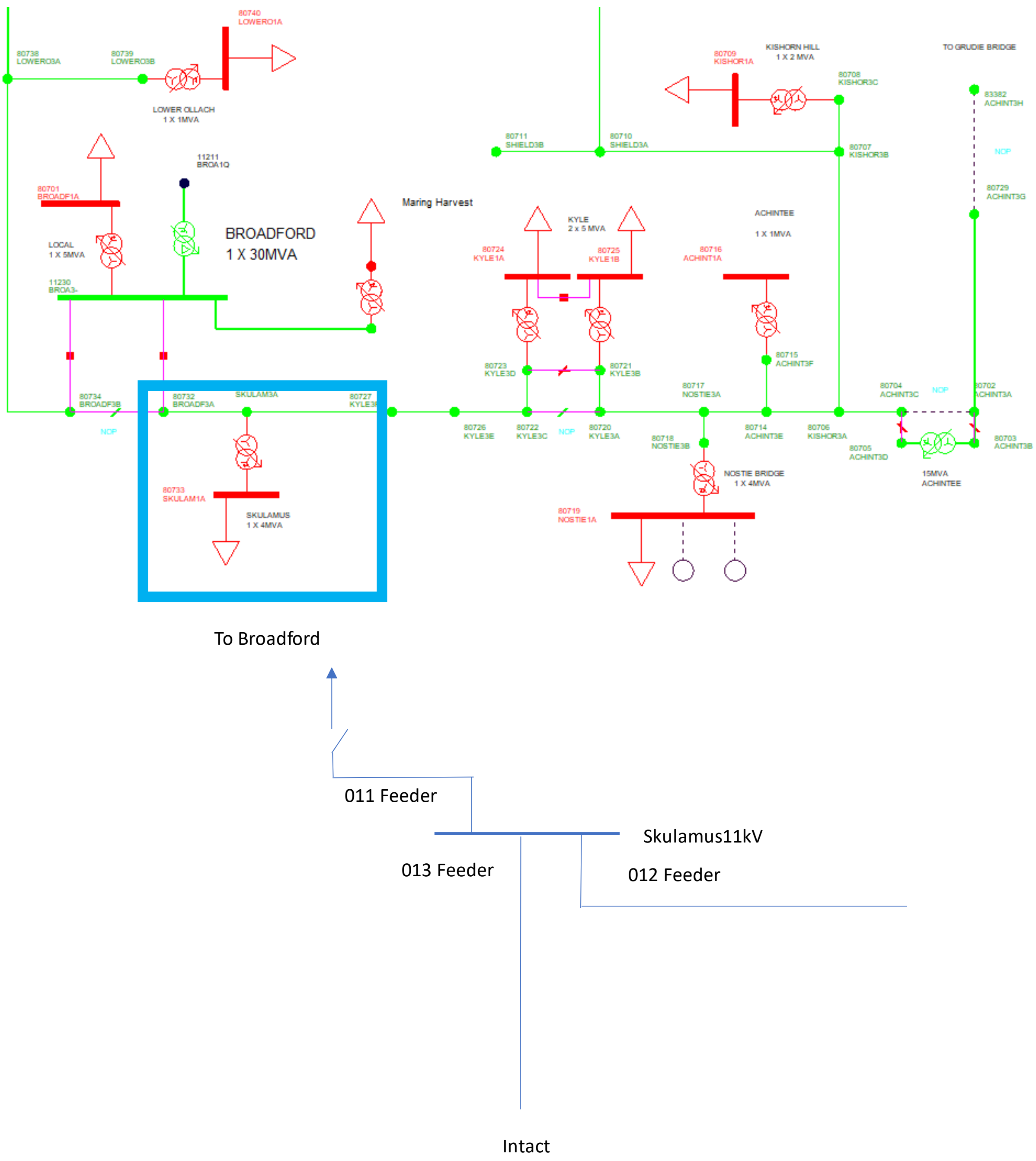

Figure 2: Skulamus Network Arrangement SLD.

4.2 Local Area Energy Plan (LAEP)

Carbon CLEVER[3] is an initiative led by Highland Council, targeting a low carbon Highlands and a carbon neutral Inverness by 2025. The plan was approved in 2014 and through this initiative, Highland Council aim to facilitate low carbon transport for its residents and visitors. The Carbon CLEVER Declaration is made up of organisations from across the public, private and voluntary sectors that have made a commitment to:

- Take action to reduce the carbon emissions from their organisations.
- Work with signatories in the Highlands and share information to promote good practice.
- Motivate and work with others to take action to reduce carbon emissions and adapt to the potential impacts of climate change.
- Produce a short annual update of actions taken and progress achieved towards reducing carbon emissions, so that this good practice can be shared.

By 2025, the Highlands will be a region where its residents and visitors can move around easily by low carbon and sustainable forms of transport. The region is well connected both in terms of transport links and through digital connectivity. Buildings across the region will have been energy renovated, and new buildings are energy efficient. Most buildings in rural areas will be heated by renewable sources. Electricity will be generated from a range of renewable sources, and excess energy can be transmitted to surrounding regions through smart grids or stored efficiently. Land and resources across the Highlands are utilised for optimal economic, social, and environmental gains.

Highland Council's targets around low carbon systems are expected to have a significant impact on demand growth within the area. This impact is visible within the SHEPD DFES projections and directly contributes to the need for investment discussed within this paper.

4.3 Demand and Generation Forecast

SHEPD have carried out extensive scenario studies through the Distribution Future Energy Scenarios (DFES) which is based on the National Grid's Future Energy Scenarios (FES) 2020 and local stakeholder input. The DFES comprises of four potential pathways for the future of energy, based on how much energy may be needed and where it might come from. The variables for the four scenarios are driven by government policy, economics and consumer attitudes related to the speed of decarbonisation and the level of decentralisation of the energy industry. SHEPD have worked closely with their partner Regen to develop the forecasts between 2020 and 2050 through enhanced engagement with the local authorities, local enterprise partnerships (LEPs), devolved governments, community energy groups and other stakeholders.

Based on the enhanced stakeholder engagement feedback, SHEPD have chosen Consumer Transformation as the baseline scenario for investment. SHEPD are protecting customers from the impact of forecasting uncertainties through baseline funding only including load related investment required in the first two years in the RIIO-ED2 period unless it is also required by other net zero scenarios. Full details on our DFES methodology, stakeholder input and regulatory treatments of load related investment can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***.

[3]https://www.highland.gov.uk/info/1210/environment/321/climate_change/2.

Table 4 and Table 5 below shows the demand projections in MW of each primary near Skulamus under the Consumer Transformation (CT) Scenario and Steady Progression (ST) scenario.

Substation	Baseline	ED1			ED2					Future		
	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Broadford	1.60	1.56	1.58	1.59	1.61	1.62	1.63	1.64	1.66	1.67	1.69	1.72
Kyle	2.40	2.41	2.41	2.42	2.43	2.44	2.46	2.48	2.50	2.52	2.55	2.59
Skulamus	2.60	2.57	2.58	2.60	2.62	2.64	2.67	2.71	2.74	2.77	2.83	2.89

Table 4: Demand projection for winter peak ST scenario (MW)

Substation	Baseline	ED1			ED2					Future		
	19/20	20/21	21/22	22/23	23/24	24/25	25/26	26/27	27/28	28/29	29/30	30/31
Broadford	1.60	1.56	1.58	1.60	1.65	1.71	1.78	1.83	1.88	1.94	2.02	2.09
Kyle	2.40	2.41	2.41	2.43	2.47	2.53	2.61	2.69	2.79	2.89	3.03	3.14
Skulamus	2.60	2.57	2.58	2.61	2.67	2.76	2.88	2.99	3.09	3.24	3.42	3.58

Table 5: Demand projection for winter peak CT scenario (MW)

Peak demand at Skulamus primary substation is expected to increase by approximately 0.4MW (CT) from 2019/20 to 2027/28.

4.4 Thermal Flow Analysis

As Skulamus has only a single primary transformer and 33kV infeed, it is susceptible to single points of failure on either the transformer or the 33kV tee circuit.

Previously undertaken SINCAL analysis confirmed that the existing 11kV interconnection from Broadford (feeder 011) is inadequate for meeting the requirements of P2. The study suggests that is not possible to restore group demand to 1 MW within 3 hours, due to thermal and voltage regulation issues. In addition, feeder 013, which has been determined in previous analysis to have loading more than 1MW, is not P2 compliant as it has no interconnecting circuits. Consequently, the entire feeder load will be lost for a first leg fault on the feeder.

Feeder 012 presently has a feeder demand just under 1MW. As future load growth is liable to push the demand at feeder 012 to more than 1MW, feeder 012 will be non-compliant with P2 in ED2. This strongly supports the need for reinforcement at Skulamus primary substation to resolve the overloading issues and by making it P2 compliant.

With the proposed option in ED2, the issues described above would be mitigated and Skulamus primary substation would be P2 compliant.

4.5 Voltage Level Assessment

SINCAL analysis has identified that the voltage at the remote end of 11kV feeder 013 has fallen to below the minimum statutory limit of 0.94. With the proposed new voltage regulator at feeder 013, the voltage at the remote end would be within the limit.

4.6 Fault Level Assessment

Fault levels remain within the existing switchgear ratings.

4.7 Network Analysis Summary

The analysis above strengthens the argument for intervention at Skulamus substation within RIIO-ED2 on top of the overall driver to become compliant with P2. The DFES forecasted increase in demand, and in turn the increased reliance on the network will impact a larger number of customers and become more severe considering the LCT uptake.

5 Summary of Options Considered

This section of the report sets out the investment options that were considered to resolve the P2 compliance issue at Skulamus Substation. As described below, a holistic approach is taken to ensure investment options that represent best value for money for network customers are identified.

5.1 Whole System Considerations

We have additionally considered the potential for using Whole System solutions (involving collaboration with third parties) to deliver this investment programme. We set out our assessment in Appendix 3. This follows our standardised approach for embedding Whole System considerations into our load and non-load investment decisions (in line with Ofgem's ED2 business plan guidance), as described in our ***Whole System (Annex 12.1)***.

Our assessment enables us to take a proportionate consideration of Whole System options, based on the feasibility of such options existing and materiality of the costs involved.

In this case, our Whole Systems assessment finds that this programme is not expected to have any wider Whole System interactions and there are no feasible Whole Systems solutions.

5.2 Summary of Options

The table below provides a high-level summary of the four investment options under consideration along with the advantages and disadvantages associated with each option. A more detailed description of each option is then provided within the proceeding sub-sections.

Option	Description	Advantages	Disadvantages	Result
1. Load Transfer	Monitor demand development	Low cost and workload.	Does not increase network capacity. Reinforcement may still be required. Not P2 compliant.	Considered but not progressed to CBA
2. Establish New Lussa Primary Substation & 11kV OHL	To make P2 compliant, new equipment will be added into existing network. This involves: • A new asset of 33kV primary substation and 33kV and 11kV circuit breakers. • A new asset of 33kV 4MVA transformer at new primary substation. • 0.2km 33kV cable loop-in/loop-out connection from Broadford to Marine Harvest 33kV circuit. • New 21km 11kV OHL. • 11kV voltage regulator.	Increase network resilience. P2 Compliant. Shorter outage time. Long term benefit.	New land purchase will be required at new primary substation and it may incur large civil costs. .	Taken forward to CBA (the Preferred Option)

3. Additional Transformer & New 11kV OHL	To make P2 compliant, new equipment will be added into existing network. This involves: • A new asset of 33 kV 6.3MVA transformer at Skulamus primary Substation. • 0.1km 33kV Teed connection from Broadford to Kyle 33kV circuit. • New 26km 11kV OHL. • 11kV voltage regulator.	Increase network resilience. P2 Compliant. Shorter outage time. Long term benefit.	Additional land purchase could be required at Skulamus. May necessitate complete re-design of the Skulamus substation which has poor access. May lose both transformers under N-1 fault.	Taken forward to CBA
4. Flexibility Solution	Flexible service contracts to reduce peak demand and defer capital investment	Utilising existing network capacity	Uncertainty of securing participants. Reinforcement may still be required.	Considered but not progressed to CBA

Table 6: Summary of Primary Switchgear Investment Options

5.3 Option Analysis

5.3.1 Option 1: Load Transfer

Skulamus primary is interconnected at 11kV to nearby Broadford primary substation. Due to limitations of 11kV feeders there is not enough capacity to accommodate the transfer of existing or new demand. This option carries a significant amount of risk and may result in increased CIs, CMLs or even non-compliance with ER P2. With this option Skulamus substation remains LI5, so for this reason the do nothing option has been deemed not viable due to the risk associated with it.

5.3.2 Option 2: Establish New Lussa Primary Substation & 11kV OHL- The Preferred Option

This option establishes a new single transformer substation in the vicinity of Lussa between Skulamus and Kyleakin to provide redundancy for a transformer or 33kV supply circuit outage at Skulamus substation.

The new substation will interconnect with Skulamus feeder 012 at 11kV and a new open point will be created at Skulamus Interconnector H700_K. Consequently, feeder 012 loading will then be transferred onto the new substation almost in its entirety. This option will improve Skulamus substation load index to LI 1.

The 33kV arrangement is shown in Figure 3.

The new substation will be supplied via a loop-in/loop-out connection from the Marine Harvest 33kV circuit. The new substation will require installation of the following items of plant:

- 4MVA primary transformer.
- Three 33kV circuit breakers to accommodate incoming supply and outgoing 33kV cable ($300mm^2$ Al) connection from Marine Harvest feeder as well 33kV transformer feeder breaker.
- HV switchgear for the outgoing 11kV feeder, the requirement is 3 no. 11kV circuit breakers for transformer and feeder.

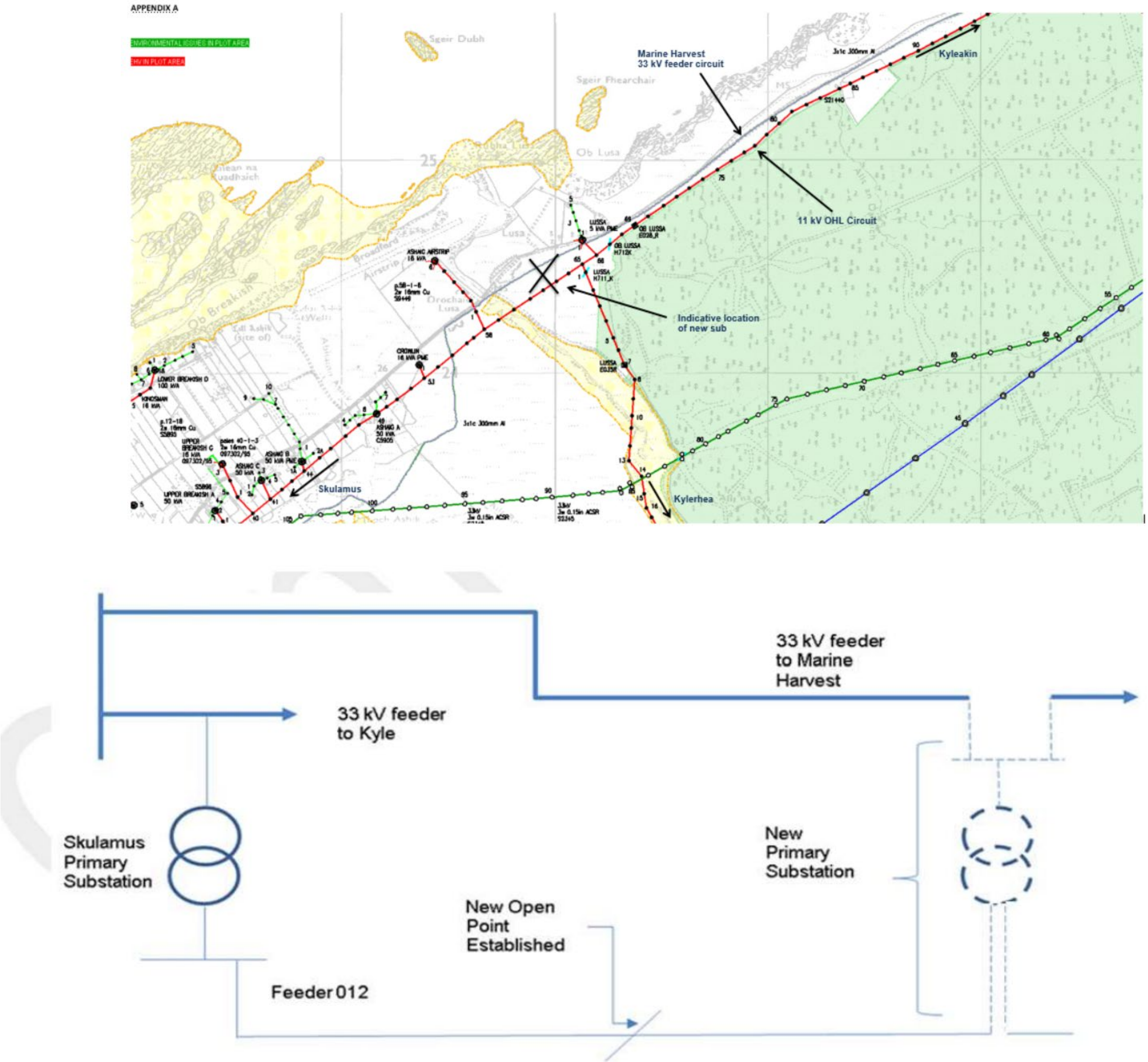

Figure 3: The connection of new primary substation.

A new 11kV 100mm^2 Cu feeder (21km) will be installed running in parallel with the existing feeder 013 and interconnecting at Upper Ostaig House A/B. A 2-Tank 200 A voltage regulator will be installed near this point. The circuit will be supplied from a tee off connection from the existing feeder 012 overhead circuit near Skulamus primary. The 11kV arrangement is shown in Figure 4.

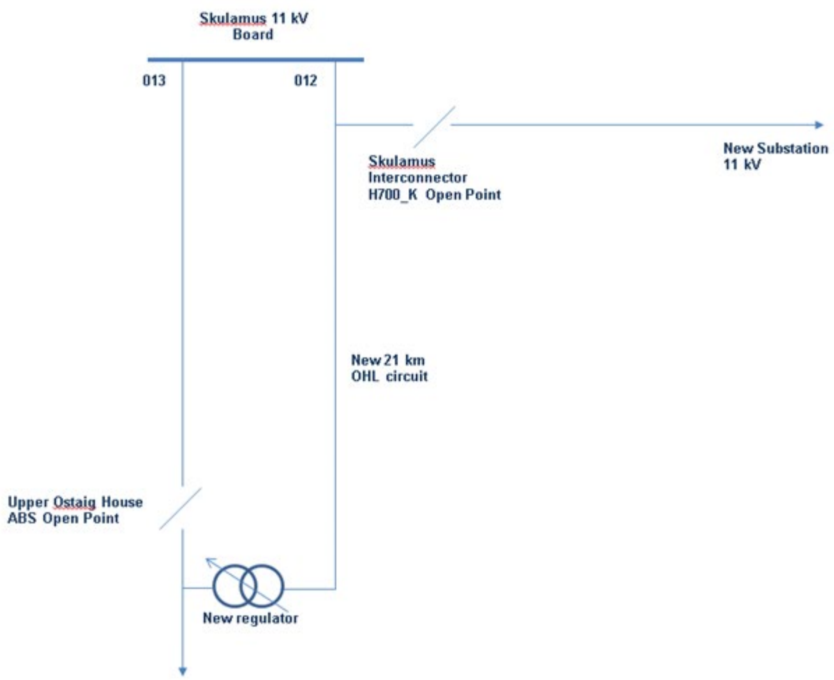

Figure 4: The proposed 11kV network.

5.4 Option 3: Additional Transformer & New 11kV OHL

Redundancy for an outage on the primary transformer may be provided by installing a second unit at Skulamus primary substation. The new transformer would be required to be rated at 6.3MVA to match the capacity of the existing unit. This option would also install new 33kV circuit infeed to Skulamus by teeing into the existing Broadford – Kyle 33 kV circuit. The 33kV arrangement is shown in Figure 5.

This option may be limited by the available space at Skulamus primary substation. This option will also lose both transformers when a fault occurs on the existing Broadford – Kyle 33 kV circuit (recovered by the 33kV backfeed from Grudie Bridge). To overcome this issue, this option could install a loop-in/loop-out connection from Marine Harvest feeder with 2 no. 33kV circuit breakers. The requirement for the extra 33kV circuit breaker will make the space issue at Skulamus even worse however.

A new 11kV 100mm^2 Cu feeder (21km) will be installed from Skulamus primary to Upper Ostaig House A/B. A 2-Tank 100A voltage regulator will be installed near this point.

To meet the future demand on 11kV feeder 012, a new 11kV 70 mm^2 Cu feeder (5km) will be installed from Skulamus primary to the vicinity of Lussa. The 11kV arrangement is shown in Figure 6.

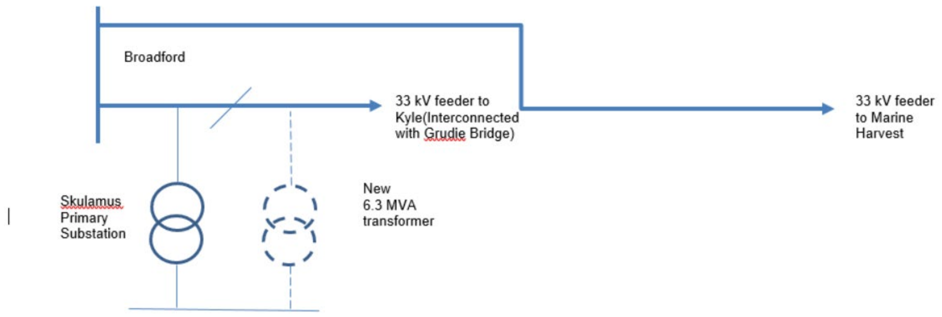

Figure 5: The 33kV Network with the second transformer at Skulamus.

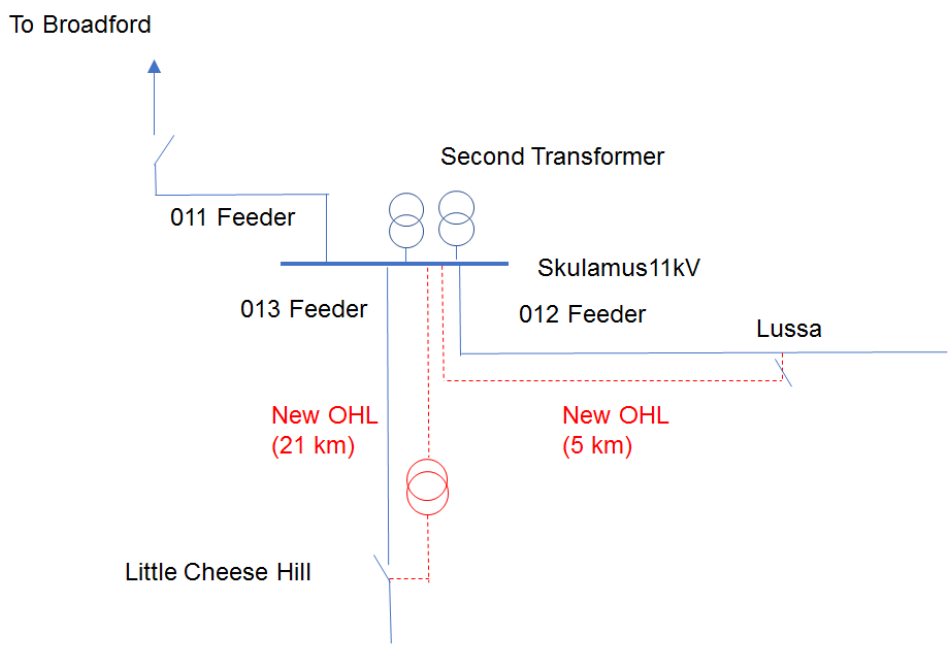

Figure 6: The 11kV Network with the second transformer at Skulamus.

5.5 Option 4: Flexible Solution

This option considers utilising customer generation capacity to actively manage the peak power flow on existing assets. This will allow SHEPD to utilise the existing network effectively and may defer or remove the need for reinforcement action.

Figure 7 below shows the peak demand at Skulamus Primary in 2027/28. As there is limited 11kV backfeed capability from Broadford primary substation on 11kV feeder 011, the substation would require flexible solution over the winter months with a demand requirement between 0-3MVA when the existing transformer at Skulamus Primary is out of service and the supply is lost. As outlined below, the output of the CBA shows this is not cost effective.

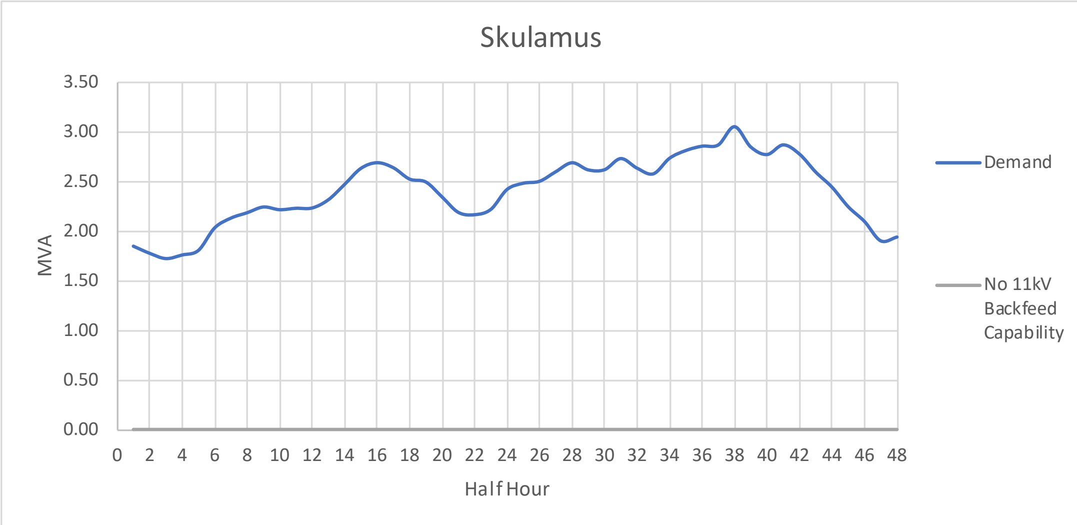

Figure 7: Skulamus peak demand 2027/28 without flexibility services.

The Baringa CBA model [4] has been also used to assess if there is any benefit on deferring the reinforcement. The methodology behind the CBA is described in more detail in the ***Load Related Plan Build and Strategy (Annex 10.1).***

The CEM framework evaluates options around timing of network investments, in particular taking into account:

- the range of different options available (e.g., reinforcing the network, using flexibility, or doing nothing);
- the time periods in which actions can be taken; and
- the existence of uncertainty, and the impact of incremental information which becomes available over time.

The MW exceedance, the daily and annual overload hours (Table 7) and the flexibility unit costs of £150 per MW per hour and £150 per MWh were used as input parameters in the CEM CBA model (full details of the flexibility methodology can be found in the ***Load Related Plan Build and Strategy (Annex 10.1)***).

	2020	2021	2022	2023	2024	2025	2026	2027	2028
Hrs/day required	0	0	0	0	0	0	0	0	24
Days/yr required	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0	64.0
Utilisation (MWh)	0.0	0.0	0.0	0.0	0.0	0	0	0	1052

Table 6: Estimated dispatch requirements for flexibility solution

Flexibility services could be used to reduce the peak demand forecast and it is estimated that no reinforcements could be deferred (shown in Figure 8).

[4] https://www.energynetworks.org/assets/images/Resource%20library/ON20-WS1A-P1%20Common%20Evaluation%20Methodology-PUBLISHED.23.12.20.pdf

Overall NPV of deferral	Optimal length of baseline deferral (years)	NPV of optimal deferral
Flexibility under CT	Baseline	£0
Flexibility under ST	Baseline	£0
Flexibility under SP	Baseline	£0
Flexibility under LW	Baseline	£0

Figure 8: Net benefit of deferring reinforcement.

Despite our commitment to the Flexibility First approach, for the Skulamus scheme the current assessment has concluded the required Flexibility could not be secured effectively within the allocated investment for the scheme and could not meet the P2 compliance for the circuit. However, prior to committing to this investment we will re-assess the ability to defer the investment using the CEM Framework to confirm any potential benefits of utilising flexibility. Should new services be available, or market prices become favourable SSEN will market test the Flexibility Services in the affected area to establish the cost, location and technical capabilities of the available flexibility before confirming the optimal route. Flexibility will only be pursued where the economic benefit of deferring the capital investment exceeds the additional cost of the flexibility service, providing an optimised net present value to consumers or potentially delivering additional whole system benefits.

Further to this, flexibility may provide OPEX benefits to SSEN and our customers during scheme delivery by;

a) Avoiding/reducing the risk of outages during planned works through load/generation management
b) Avoiding/reducing the need for Mobile Diesel Generation in planned or unplanned outage scenarios
c) Reducing the scale of the works through the implementation of a 'Hybrid' scheme, part reinforcement and part Flexibility.

The above opportunities will be reviewed, and Flexibility secured should the CEM Framework CBA prove a positive benefit, with justification of the decisions/reviews presented as required.

Further detail of our Flexibility First approach and assessment methodology can be found in ***DSO Strategy (Annex 11.1) Appendix F - Delivering Value through Flexibility.***

6 Summary of Cost Benefit Analysis (CBA)

This section provides an overview of the results from the Cost Benefit Analysis (CBA). This detailed exercise has been undertaken to support the investment strategies discussed within this EJP.

6.1 CBA of investment options:

Ofgem's RIIO-ED2 standard CBA template was used to assess costs and benefits of the conventional options for each option individually. Capital reinforcement costs, CI/CML penalties, network losses and other societal benefits are the key parameters used in the options progressed. The customer interruptions / customer minutes lost (CI/CML) were calculated based on the improvement of health conditions of the assets and the probability of a failure.

Further information on our Cost Benefit Analysis (CBA) approach is set out within our ***Cost Benefit Analysis Process (Annex 15.8)***.

6.2 CBA Results

The CBA results below, demonstrate that the most cost-effective solution is option 2 'Establish New Lussa Primary Substation & 11kV OHL', as it has the least NPV against the required investment. It is clear that the investment reduces the CI's at Skulamus Substation immediately within RIIO-ED2, while providing efficient and enduring long-term security of supply as we move towards a Net Zero network. Therefore, based on the CBA results option 2 is preferred solution to address the P2/7 compliance issue in 2027/28.

Summary of Cost

Options	Unit	2024	2025	2026	2027	2028	ED3+	Total £k
Option 2 – Additional Transformer & 33kV OHL line & 11kV Cable (Preferred Option)	**£k**	0	0	0	0	2,169	0	2,169
Option 3 – Additional Transformer & 33kV OHL line & 11kV Subsea	**£k**	0	0	0	0	2,425	0	2,425

Cost Benefit Analysis comparisons

Options	Net Present Value (NPV) After 45 Years (£k)	Investment (£k)
Option 2 – Establish New Lussa Primary Substation & 11kV OHL (Preferred Option)	-1,855	2,169
Option 3 – Additional Transformer & New 11kV OHL	-2,065	2,425

6.3 Options Summary

Option 1 is the lowest capital costs and may appear to be the attractive option. However, this option does not provide sufficient capability to meet the projected network requirements and is not considered a cost effective long-term solution.

Option 4 does not provide the required level of security of supply through the use of flexibility solution.

The only remaining options which satisfy the P2 compliance requirements are options 2 and 3. These options both provide the required security of supply through additional assets at Skulamus substation. Option 2 provides an opportunity for a clean off circuit build in a newly established substation site, whereas option 3 requires work in an existing site with space issues that will present additional challenges to overcome.

Therefore, option 2 is the preferred solution.

6.4 Costing Approach

Our RIIO ED2 Business Plan costs are derived from our outturn RIIO ED1 expenditure. We have modified costs per activity, capturing and reporting those adjustments in our cost-book. By tying our costs back to reported outturn, real life data has been used which provides multiple data points both SSEN and the Regulator can use to benchmark costs efficiently.

It provides a high level of cost confidence in our Business Plan cost forecast for RIIO ED2. Through our benchmarking analysis, we recognised that not all Non-Load related RIIO-ED1 actual unit costs sit within the upper quartile efficiency band. Where this is the case, we have applied a catch-up efficiency to those cost categories.

Further detail on our unit cost approach, cost efficiency and cost confidence for RIIO-ED2 can be found within our ***Cost Efficiency (Annex 15.)1***[5]. Following our draft Business Plan, we have continued to develop project scopes and costs, utilising valuable stakeholder feedback. We have included developments of our Commercial Strategy within the updated project scope and delivery strategy.

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[5] ***Cost Efficiency (Annex 15.1)***.

7 Deliverability and Risk

Between our draft and final Business Plans we have carried out a more detailed deliverability assessment of our overall plan as a package and its component investments. Using our draft Business Plan investment and phasing as a baseline we have followed our deliverability assessment methodology. We have assessed any potential delivery constraints to our plan based on:

- In-house workforce capacity and skills constraints based on our planned recruitment and training profile and planned sourcing mix as well as the efficiencies we have built into our Business Plan ***(detailed in our Workforce Resilience Strategy in (Annex 16.3)*** and ***Cost Efficiency (Annex 15.1)***
- Assessment of the specific lead and delivery timelines for the asset classes in our planned schemes
- We have evaluated our sourcing mix where there were known delivery constraints to assess opportunities to alleviate any constraints through outsourcing
- We have engaged our supply chain detailed in our ***Supply Chain Strategy (Annex 16.2)*** to explore how the supply chain could support us to efficiently deliver greater volumes of work and how we could implement a range of alternative contracting strategies to deliver this
- We have also engaged with the supply chain on the delivery of work volumes that sit within Uncertainty Mechanisms to ensure we have plans in place to deliver this work if and when the need arises
- Specific to load schemes: We have carried out flexibility assessments at all voltage levels in order to understand when we can defer reinforcement through paying for flexibility services, therefore ensuring our investment profile is deliverable and at the lowest cost to consumers see ***Flexibility within Load Related Plan Build and Strategy (Annex 10.1)***
- We have assessed the synergies between our planned load, non-load and environmental investments to most efficiently plan the scheduling of work and minimise disruption to consumers

This investment scheme is part of the wider load-related investment portfolio in RIIO-ED2. SSEN have developed a strategy to deliver a much larger volume of work in comparison with the level of investment in ED1. We have engaged with our supply chain to negotiate the most effective unit costs and we have taken measures to ensure we secure a future workforce with the right skills and competencies to deliver capital projects in ED2.

In ED1, SHEPD have delivered a number of 33kV and 11kV OHL projects using internal workforce. The experience and skills acquired from these projects lay the foundation for the delivery of the proposed option within this paper.

As the preferred option requires the new site to install the new assets, any potential site issues can lead to the risks for the scheduled delivery. The site survey and land purchase shall be managed in an efficient way to mitigate the potential risks for the proposed option within this paper.

This scheme was originally included in our baseline for delivery during the RIIO-ED1 period, however, delivery constraints alongside the existing derogation means it is not economic or efficient to progress with this project within RIIO-ED1. Our decision to defer this scheme means that, where necessary, we are able to use this allowance to efficiently deliver other projects which may have arisen within RIIO-ED1. This allows us to continually meet the requirements of our network and the needs of our customers throughout the price control.

8 Conclusion

This EJP has raised the need for load related investment at Skulamus Primary substation within the ED2 price control period. This need for investment is driven by the existing non-compliance with P2/7 and is further justified by the forecasted demand increase. To avoid security of supply issues for customers on Skulamus Primary, reinforcement is proposed to remove this non-compliance.

Four investment options have been considered and the preferred solution involves a combination of adding a new 4MVA transformer at Lussa, installing 0.2km of 33kV cable and 21 km 11kV OHL. All options are supported by a Cost Benefit Analysis (CBA) which provides further breakdown of economic viability over a 45-year period.

The proposed ED2 investment with the combined scheme total of £2.17m. It is proposed that all reinforcement is carried out in the 2027/28 financial year to minimise the risk of thermal overload and network non-compliance.

Appendix 1: Geographic Views

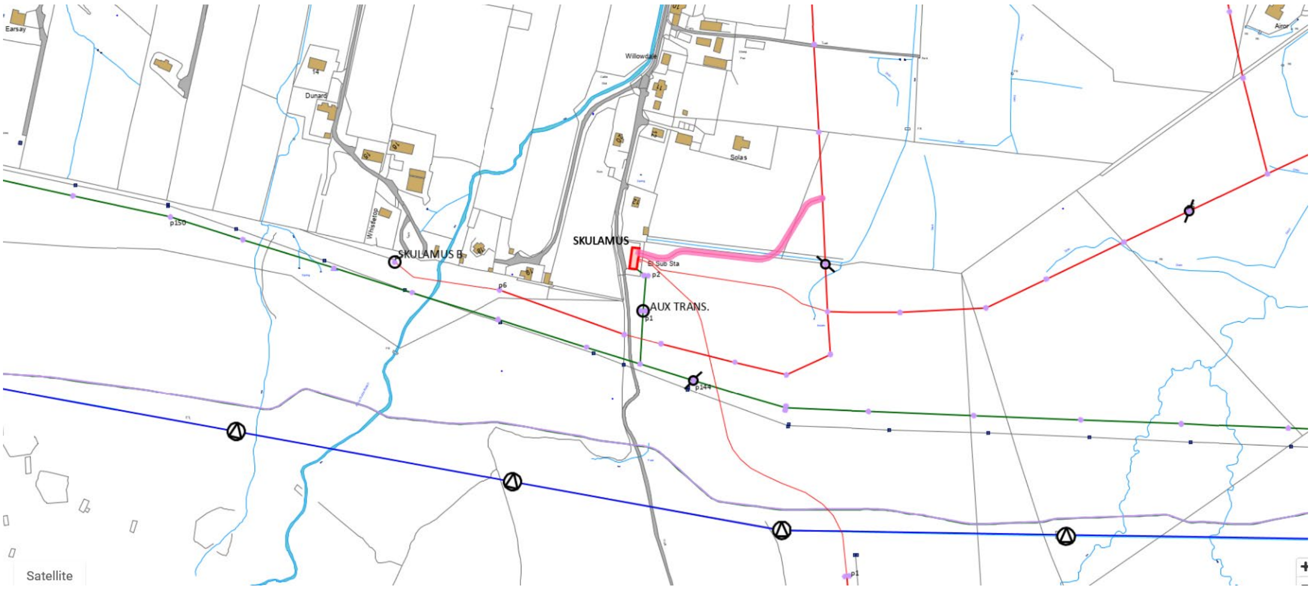

Figure 9: Skulamus Primary Substation.

Appendix 2: Relevant Policy, Standards, and Operational Restrictions

The policies, manuals and standards and operational restrictions relevant to the content of this paper.

Policy Number	Policy Name / Description
TG-NET-OHL-010	Load Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-012	Short Circuit Ratings of Overhead Lines – Data Sheet
TG-NET-OHL-104	Electrical Constants for Overhead Lines- Data Sheet
TG-NET-CAB-009	Load Ratings of LV to 33kV Underground Cables – Design Data
TG-NET-CAB-010	Electrical Constants for LV to 33 kV Underground Cables- Data Sheet
TG-NET-CAB-011	Short Circuit Ratings of 6.6kV to 33kV Underground Cables - Design Data

Table 7: Relevant documents

Appendix 3: Whole Systems consideration

In augmenting our decision-making processes to consider Whole System solutions, we have introduced an assessment to identify where a Whole Systems CBA would be a useful decision-making tool for ED2 load and non-load schemes. While our work with the ENA to undertake Whole Systems CBAs is ongoing, we have introduced the 'Whole Systems CBA test' to identify where a scheme may be suitable for a Whole Systems CBA to be conducted. Where a Whole Systems CBA is determined to be a useful decision-making tool, these would be conducted in addition to the standard Ofgem CBA and/or SSEN's flexibility CBA. We have introduced this test in line with Ofgem's expectations for "proportionality when submitting a Whole System CBA. For example, smaller or simple projects following the standard CBA template, whereas larger or more complex projects requiring bespoke analytical approaches" (Ofgem BPG, section 4.28, p.34).

The 'Whole Systems CBA test' involves assessing each investment scheme of over £2m (the threshold to develop an EJP for load and non-load investments) against 5 tests. These 5 tests help determine whether a Whole Systems CBA is a useful decision-making tool based on the characteristics of the scheme, including whether it will have wider cross sector or societal impacts.

Details on each of the tests are provided in case study 6 in ***Whole Systems (Annex 12.1)***. Tests 1-3 are aligned with the ENA's guidance for Whole System CBA tests. We have added Tests 4 and 5 to clarify whether a Whole Systems CBA is required based on the materiality / proportionality of the investment (Test 4) and whether a flexibility CBA only is sufficient (Test 5). Table 10 below outlines our Whole Systems CBA test for Skulamus Primary P2 Compliance.

Scheme	Test 1: Are there Whole Systems interactions, or is there potential for it?	Test 2: Could a Whole Systems CBA drive you to make a different decision?	Test 3: Is a Whole Systems CBA reasonable?	Test 4 - Is the project valued at over £2m?	Test 5 - Is the investment plan related to procuring flexible solutions only?
Skulamus Primary P2 Compliance	No – We consider there to be limited potential for Whole Systems interactions with third parties to deliver this investment programme, and accordingly we do not consider there to be potential for Whole Systems solution(s).	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	No – As noted under Test 1 we do not consider there to be potential for Whole Systems solution(s) in this case.	Yes	No

Table 8: Whole Systems CBA test for Skulamus Primary P2 Compliance

As the result of tests 1, 2 and 3 above is "No", a Whole Systems CBA is not required for this investment. It is not expected to have any wider Whole System interactions or potential Whole Systems solutions.