Stranraer Primary Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-024-CV1-EJP

Issue	Date	Comments
Issue 0.1	Mar 2021	Issue to internal governance and external assurance
Issue 0.2	Apr 2021	Reflecting comments from internal governance
Issue 0.3	May 2021	Reflecting external assurance feedback
Issue 1.0	Jun 2021	Issue for inclusion in Draft Business Plan submission
Issue 1.1	Oct 2021	Reflecting updated DFES forecasts
Issue 1.2	Nov 2021	Reflecting updated CBA results
Issue 2.0	Dec 2021	Issue for inclusion in Final Business Plan submission

Scheme Name	Stranraer Primary Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Voltage Constraints		
Reference	ED2-LRE-SPD-024-CV1		
Output	Load Index		
Cost	£2.467m		
Delivery Year	2025-2028		
Reporting Table	CV1		
Outputs included in ED1	~~Yes~~/No		
Business Plan Section	Develop the Network of the Future		
Primary Annex	Annex 4A.2: Load Related Expenditure Strategy: Engineering Net Zero Annex 4A.6: DFES		
Spend Apportionment	**ED1**	**ED2**	**ED3**
	£m	**£2.467m**	**£m**

Technical Governance Process

Project Scope Development

IP1(S)

To be completed by the Service Provider or Asset Management. The completed form, together with an accompanying report, should be endorsed by the appropriate sponsor and submitted for approval.
IP1 – To request project inclusion in the investment plan and to undertake project design work or request a modification to an existing project
IP1(S) – Confirms project need case and provides an initial view of the Project Scope
IP2 – Technical/Engineering approval for major system projects by the System Review Group (SRG)
IP2(C) – a Codicil or Supplement to a related IP2 paper. Commonly used where approval is required at more than one SRG, typically connection projects which require connection works at differing voltage levels and when those differing voltage levels are governed by two separate System Review Groups.
IP2(R) – Restricted Technical/Engineering approval for projects such as asset refurbishment or replacement projects which are essentially on a like-for-like basis and not requiring a full IP2
IP3 – Financial Authorisation document (for schemes > £100k prime)
IP4 – Application for variation of project due to change in cost or scope

PART A – PROJECT INFORMATION

Project Title:	**Stranraer Primary Reinforcement**
Project Reference:	**ED2-LRE-SPD-024-CV1**
Decision Required:	**To give concept approval for the use of network STATCOM to manage a voltage constraint in the Stranraer demand group.**

Summary of Business Need:

Stranraer 33/11kV primary group is geographically located in the Dumfries and Galloway region of SP Distribution (SPD) licence area. The Stranraer primary substation, comprising of two 33/11kV transformers, is fed from Glenluce GSP via long 33kV overhead line circuits (14km and 15.5km) and supplies 5,852 customers. The Stranraer demand group is presently approaching voltage limits. Studies indicate that the forecast demand growth and Low Carbon Technologies (LCT) uptake in RIIO-ED2 will lead to steady state undervoltage and voltage step issues beyond operational management. It is proposed to carry out system reinforcement in the RIIO-ED2 price control period in order to mitigate the voltage violations and maintain the steady state voltage of the 33kV network to within +/- 6% of the declared voltage under the ESQCR 2002 and maintain voltage step within +/- 10%. The Baseline View forecasts up to 1,153 Electric Vehicles and 775 Heat Pumps during RIIO-ED2.

"Stranraer Primary Substation Voltage Reinforcement" was included in the RIIO-ED1 business plan, however measured demand at Stranraer primary during the RIIO-ED1 period was lower than forecast. As a result, the scheme was deferred, with investment now proposed in the RIIO-ED2 business plan.

Summary of Project Scope, Change in Scope or Change in Timing:

The proposed solution to mitigate the identified voltage violations in RIIO-ED2 is an innovative reactive power compensation scheme comprising of the installation of a ±7.5MVAr STATCOM at Stranraer primary substation. Flexibility services have been procured to manage the network risk through the delivery stage at a cost of £51k.
The estimated cost for the above is £2.467m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. The proposed solution represents the lowest cost and is an efficient solution to meet the forecast demand growth when compared with the identified alternative scheme.

Expenditure Forecast (in 2020/21 prices)

Licence Area	Reporting Table	Description	Total (£m)	Incidence (£m)				
				2023/24	2024/25	2025/26	2026/27	2027/28
SPD	CV1	Primary Reinforcement	**2.416**	-	-	0.242	1.208	0.966
SPD	CV1	Flexible Services	**0.051**	0.002	0.005	0.011	0.032	-
SPD	**Total**		**2.467**	**0.002**	**0.005**	**0.253**	**1.240**	**0.966**

PART B – PROJECT SUBMISSION

Proposed by	Mark Friese	Signature	Date: 30/11/2021
Endorsed by	Russell Bryans	Signature	Date: 30/11/2021

PART C – PROJECT APPROVAL

Approved by	Malcolm Bebbington	Signature	Date: 30/11/2021

Contents

1 Introduction

Stranraer 33/11kV primary group is geographically located in the Dumfries and Galloway region of SP Distribution (SPD) licence area.

Stranraer primary demand group has firm capacity of 15.2MVA. Our Baseline View projects a peak demand of 16.2MVA by 2028, including an expected uptake of up to 1,153 electric vehicles and 775 heat pumps. By the end of the RIIO-ED2 price control period (hereinafter referred to as "RIIO-ED2"), Stranraer demand group, will be Class "C", as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7.

The Stranraer demand group is presently operating close to voltage limits. Studies indicate that additional demand growth and LCT uptake will lead to steady state undervoltage (<0.94 pu) and voltage step issues (> -10%) beyond operational management.

Therefore, in order for SP Energy Networks (SPEN) to maintain voltages within statutory limits it is proposed to carry out system reinforcement in the RIIO-ED2 price control period.

To mitigate the identified voltage issues in the group, it is proposed to install a new reactive power compensation device at the existing Stranraer primary substation. Studies have been undertaken to assess a wide range of options to determine the optimum location and technology of the reactive power compensation device (static/dynamic) providing the required voltage support. Stranraer has been identified as the most suitable location for fast-acting dynamic MVAr support in the form of a ±7.5MVAr STATic synchronous COMpensator (STATCOM) to manage voltage step issues. Installation of the STATCOM solution will mitigate both steady state and voltage step issues in the group through RIIO-ED2 and RIIO-ED3.

The estimated cost for the above is £2.467m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. The proposed solution represents the lowest cost and the most efficient option to mitigate the voltage issues resulting from the forecast demand growth when compared with the identified alternative scheme.

"Stranraer Primary Substation Voltage Reinforcement" was included in the RIIO-ED1 business plan, however measured demand at Stranraer primary during the RIIO-ED1 period was lower than forecast. As a result, the scheme was deferred, with investment now proposed in the RIIO-ED2 business plan.

Flexibility services have been procured to reduce the network risk through the delivery stage at a cost of £51k. We will continue to tender for flexibility services in this area in order to test the market for technically compliant flexibility solutions to resolve this complex voltage constraint.

Demand is forecast to remain below the firm capacity until 2028. Therefore, it is proposed to start the works in 2025/26, with completion in 2027/28. A capacity release of 7.8MVA will be claimed in 2027/28 at the end of the project.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Stranraer Primary 11kV demand group. The existing 11kV network is located on the west coast of Scotland and is Dumfries and Galloways second largest town with nearly 13,000 inhabitants, of which, 5,852 are supplied directly from Stranraer Primary. The primary substation is served by two 19MVA, ABB, 33/11kV transformer (2017), the area is a coastal and rural environment, and the local network comprises of a mix of underground cable (UGC) and overhead line (OHL).

Stranraer primary is interconnectable at 11kV with Glenluce, Pinwherry, Auchneel and Barrhill substations. It is fed from Glenluce GSP, via the 33kV network shown in Figure 1.

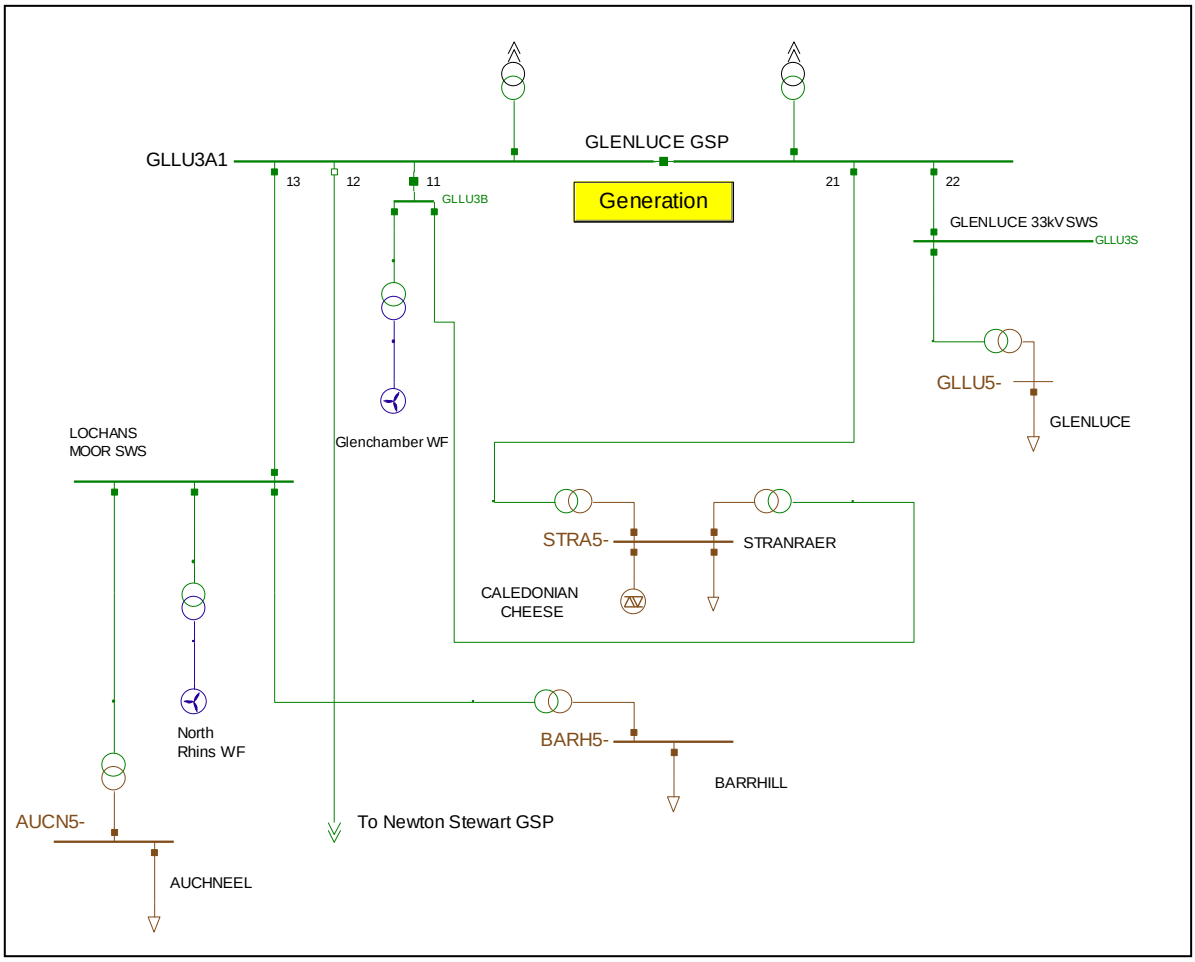

Figure 1. Existing 33kV Network

2.2 Group Demand & Security of Supply

The maximum measured demand on the Stranraer 33/11kV transformer was 13.8MVA (2017); which is EREC P2/7 class of supply 'C' (over 12MW and up to 60MW) and must be secured for a first circuit outage (FCO). Stranraer primary has firm capacity of 15.2MVA.

2.3 Embedded Generation

There is ca. 1.12MW of embedded generation connected to the network.

2.4 Fault Levels

Studies indicate that with the authorised customer connections there are no fault level issues at Stranraer primary.

3 Needs Case

The Stranraer primary demand group is supplied via long 33kV overhead line circuits from Glenluce GSP. With the forecast demand growth in RIIO-ED2, power flow analysis indicates that the network will be at risk of voltage steps greater than 10% and steady-state voltage excursions outside of statutory limits. The primary transformer will be at the limits of its tap operation.

As the network will be "Non-Compliant" it is proposed to carry out system reinforcement in the RIIO-ED2 price control period in order to accommodate the future demand growth within the area, maintain the steady state voltage of the 11kV network to within +/- 6% of the declared voltage under the ESQCR 2002 and maintain voltage step within +/- 10%.

Further to comply with section 9 of the Electricity Act and Condition 21 of our licence obligation "to develop and maintain an efficient, coordinated and economical system for the distribution of electricity" an enduring design solution is required in order to satisfy the existing customer requirements and accommodate future load growth. This concept paper covers the network solutions required to mitigate the voltage violations.

3.1 Forecast Demand

The system is forecast to grow and exceed firm capacity within the RIIO-ED2 period. This forecast is based on actual system measurement data from the Process Instrumentation (PI) system and stakeholder endorsed Distribution Future Energy Scenarios (DFES) and considers our pipeline of known developments.

3.1.1 Distribution Future Energy Scenarios

DFES includes granular forecasts to 2050 for demand, generation and low carbon technologies. They assess credible future scenarios covering a range of uncertainties, including differing levels of consumer ambition, policy support, economic growth and technology development and the forecasts are underpinned by extensive stakeholder engagement.

The peak demand forecast based on the SPD Distribution Future Energy Scenarios is depicted in Figure 2. The anticipated total electric vehicle and heat pump uptakes based on the future energy scenarios are depicted in Figure 3.

The scenario range considers the range of Net Zero compliant scenarios developed by us, the Electricity System Operator (ESO), and the Climate Change Committee (CCC). These are the five scenarios from the CCC 6th carbon budget, and the Leading the Way and Consumer Transformation scenarios from our DFES and the ESO Future Energy Scenarios (FES). We haven't included the System Transformation (ST) scenario as it is an outlier against the other Net Zero compliant scenarios and does not achieve interim carbon targets.

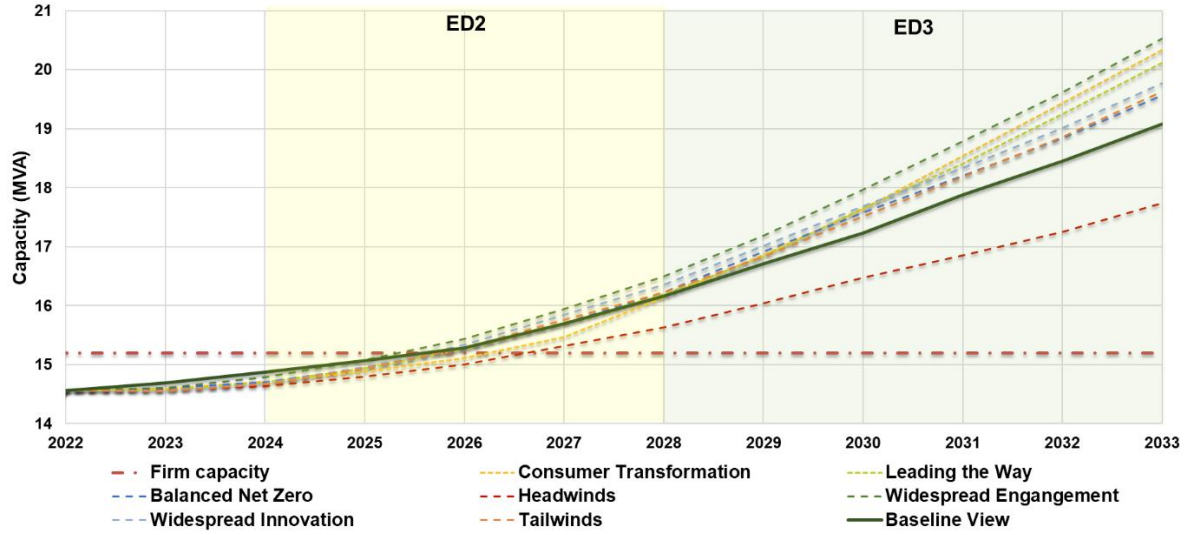

Figure 2. Demand (MVA) forecast for Stranraer demand group

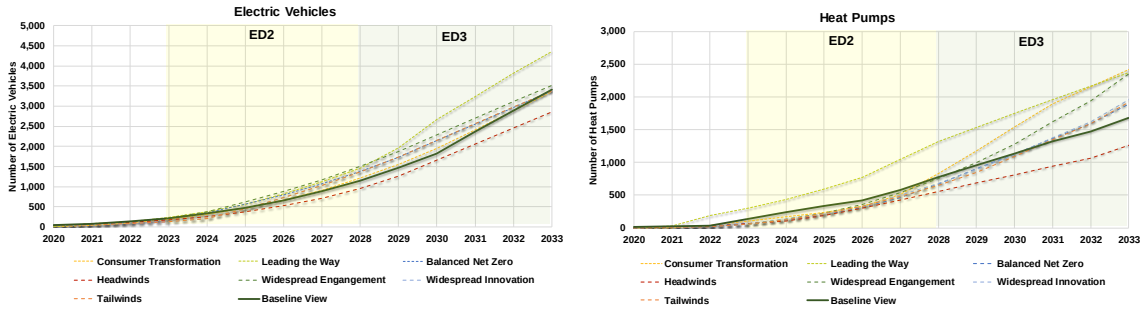

Figure 3. Forecast Electric Vehicle and Heat Pump uptakes for Stranraer demand group

3.1.2 Baseline View

For the Stranraer group demand, the forecast demand growth under our Baseline scenario, along with the firm capacity and utilisation through to RIIO-ED3 period is shown in Table 3.1.

Table 3.1. Baseline View forecast

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	14.6	14.7	14.9	15.1	15.3	15.7	16.2	16.7	17.2	17.9	18.5	19.1
Firm Capacity (MVA)	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2
Utilisation (%)	96	97	98	99	101	103	106	110	113	118	121	125
Load Index	LI3	LI3	LI3	LI4	LI4	LI5	LI5	LI5	LI5	LI5	LI5	LI5

3.2 Network Impact Assessment

Detailed network studies covering network intact and outage (N-1) conditions and fault level assessments were carried out for the 33kV network fed from the Stranraer group considering the different demand forecast scenarios. The findings from the network impact assessments are detailed in sections below.

3.2.1 Voltage Constraints

Table 3.2 shows the identified voltage constraints on the 33/11kV network level.

Table 3.2. Voltage constraints at 33/11kV level

Network Item	Voltage	Outage
Stranraer 11kV busbar	11kV	N-1

Figure 4 shows the step voltage results for the loss of a circuit (N-1) between Glenluce GSP 3A2 and Stranraer primary T1.

DPC4.2.3 of the Distribution Code, and associated EREC P28 - Issue 2 (2019) require that voltage step changes are limited to less than ±10% for very infrequent events[1]. A forecast voltage step change of 10.4% by the end of RIIO-ED2 requires intervention for Stranraer primary to remain compliant.

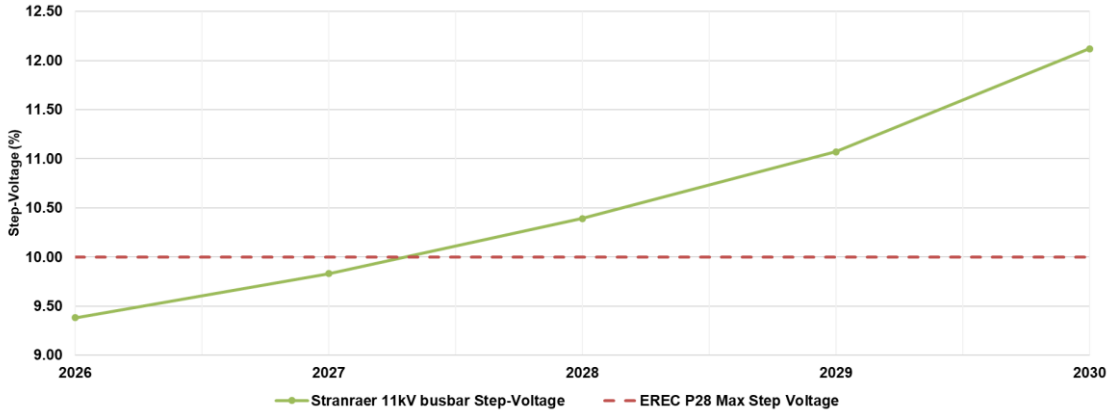

Figure 4. Stranraer Primary step-voltage from 2026-2030

The EQSCR requires network operators to maintain the steady state voltage of the 33kV network to within +/- 6% of the declared voltage. Figure 5 shows the steady state voltage results for Stranraer primary 11kV busbar during a first circuit outage (FCO) under the loss of the Glenluce GSP 3A2 - Stranraer primary T1 circuit. Voltage below statutory limits (<0.94p.u.) are forecast on the 11kV busbar, starting in 2028.

[1] Very Infrequent events are defined as no more than 1 event in 3 calendar months and no more than 1 event is permitted per day, consisting of up to 4 RVCs, each separated by at least 10 minutes with all switching completed within a two-hour window.

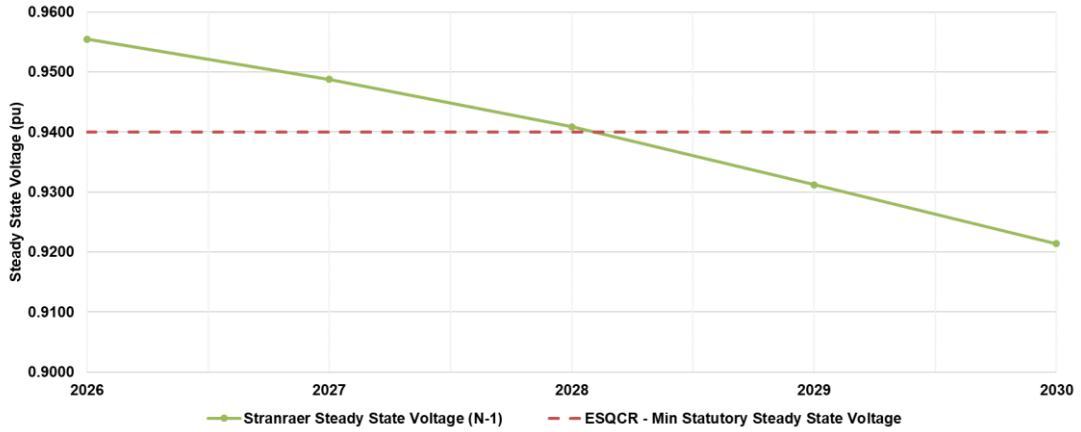

Figure 5. Stranraer Primary (N-1) steady state voltage from 2026-2030

3.2.2 Flexibility Services

In order to manage the network risk on the 11kV network, our assessment indicates that the risk of Stranraer primary exceeding the 15.2MVA firm capacity and security of supply constraints in the group starts from the year 2023/24 throughout to the year 2028 for the most onerous scenario including an additional 5% for the asset protection margin. This is shown Table 3-3. The detailed results from the half hourly profile-based simulations are furnished in Appendix 1.

Table 3-3. Network annual hours at risk and flexible capacity tendered in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	60	87	120	206	400
Required Flexible Capacity (MW)	0.30	0.62	0.93	1.58	2.35

4 Optioneering

Table 4.1 shows a summary of the options considered for this reinforcement. The baseline option represents the lowest cost conventional option, i.e. the minimum level of intervention without application of innovation.

Table 4.1. Longlist of solution options

#	Options	Status	Reason for rejection
(a)	Do nothing	Rejected	Not compliant with statutory voltage limits.
(b)	Intervention plan using only Energy Efficiency	Rejected	Discounted due to lower cost effectiveness (peak MW reduction per £) and the number of individual interventions required across the wide area supplied by this network.
(c)	Establish a third 33kV circuit between Glenluce GSP and Stranraer Primary	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	Install higher rated circuits between Glenluce GSP and Stranraer Primary	Rejected	Does not satisfy needs case. Increases steady state voltage to within statutory limits (>0.94pu). Step voltage is still beyond the -10% recommendation.
(e)	Installation of ±7.5MVAr STATCOM at Stranraer Primary.	Shortlisted as **Option 1** in Detailed Analysis	
(f)	Installation of Mechanically Switched Capacitor (MSC) at Stranraer Primary.	Rejected	Does not satisfy needs case Increases steady state voltage to within statutory limits (>0.94pu). Step voltage is still beyond the -10% recommendation.
(g)	Establish a new primary substation	Shortlisted as **Option 2** in Detailed Analysis	

5 Detailed Analysis & Costs

5.1 Proposed Option (Option 1) – Installation of STATCOM

The proposed option for this scheme is to install a new reactive support device at the existing Stranraer Primary substation to mitigate the forecast voltage issues. Table 5.1 shows the scheme summary.

Table 5.1. Proposed option summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Innovation/Smart	Stranraer Primary Reinforcement	Install a +/- 7.5MVAr STATCOM	2.467	-

To mitigate the forecast voltage issues in the group, it is proposed to install a new reactive support device at the existing Stranraer Primary substation. Studies have been undertaken to identify the identify the most suitable location, capacity and speed of the operation of the reactive power requirement. This included consideration of static or dynamic devices at either 11kV or 33kV, as well as a range of capacities of compensation devices between 5MVAr and 15MVAr.

Stranraer Primary has been identified the most suitable location for fast-acting dynamic MVAr support in the form of a ±7.5MVAr STATCOM connected directly to the 11kV busbars. This proposal is sufficient to manage voltage step and steady state voltage issues through RIIO-ED2 and RIIO-ED3.

The STATCOM solution is an innovative solution, comprising of a DC capacitor behind a power electronics voltage source converter to act as either a sink or source of reactive power. This provides fast acting, dynamic and controllable voltage regulation. The STATCOM device will be controlled around a 0MVAr setpoint, during Intact conditions, to enable the device to quickly respond with MVArs during contingent conditions. Cost estimates include for provision of a ±7.5 MVAr STATCOM.

The proposed STATCOM solution is shown in Figure 6. There is space to accommodate the STATCOM within the existing site as shown in Figure 7.

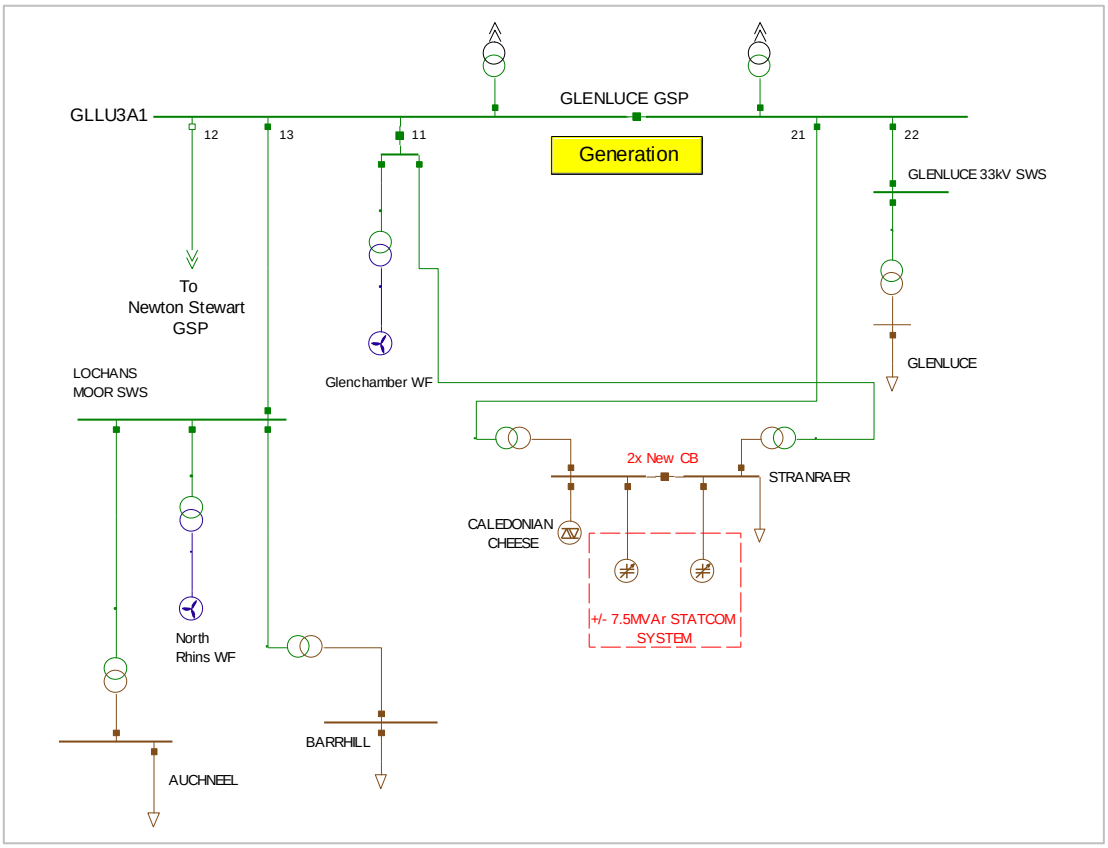

Figure 6. Proposed connection of +/- 7.5MVAr STATCOM

Figure 7. Geographical view of the area

Based on the response to the flexibility tender run in Spring 2021, flexibility as a viable option to delay reinforcement has been discounted. However, in order to facilitate market growth, manage network constraints during project delivery and enable network outages, the total of 3.4MW of capacity has been accepted between 2023-2027, which is shown in Table 5.2. The cost of flexibility services has been added to the proposed solution.

Table 5.2. Accepted flexible capacity from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.3	0.6	0.9	1.6	-

Table 5.3 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.3. Proposed option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	0.3	0.035	0.035	-
6.6/11kV CB (GM) Primary	2	0.055	0.055	-
Pilot Wire Underground	0.3	0.033	0.033	-
Civil Works at 33 kV & 66 kV Substations		0.122	0.122	-
Other Costs (Identify Below)		2.170	2.170	-
Flexibility		0.051	0.051	
Total Costs		2.467	2.467	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Installation of +/-7.5MVAr STATCOM (£2m)				
Planning and Design (£100k)				
Environmental consideration (£10k)				
33kV telecoms upgrade (£30k)				
Remedial works on the existing site (£30k)				

Demand is forecast to remain below the firm capacity until 2028. Therefore, it is proposed to start the works in 2025/26, with completion in 2027/28. A capacity release of 7.8MVA will be claimed in 2027/28 at the end of the project.

5.2 Baseline Option – Establish a third circuit to Stranraer Primary from Glenluce GSP

This option considers installation of a third 33kV connection to Stranraer primary from Glenluce GSP. The option would enable 9.5MVA additional network capacity. In the event of a single circuit outage, the demand would be served by the remaining two circuits. Consequently, the voltage step remains EREC P28 compliant. Table 5.4 shows the scheme summary. This option is rejected based on cost.

Table 5.4. Baseline option summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Stranraer Primary Reinforcement	Install 3rd circuit to Glenluce and replace Glenluce 33kV switchboard	4.541	-

The indicative route of the third 33kV circuit is shown in Figure 8 and Figure 9 shows 33kV network for this option. The existing switchboard comprises Hawker Sidley HG 36 circuit breakers on an air insulated busbar. The existing switchboard cannot be extended any further. It is therefore recommended that a new switchboard is installed, which will replace the existing switchboard at Glenluce GSP, in order to establish the additional connection to Stranraer.

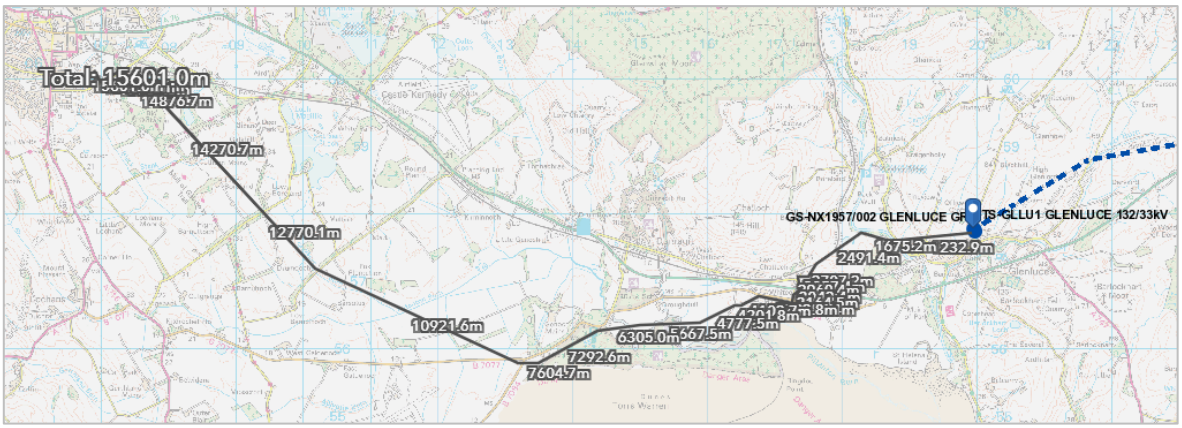

Figure 8. Indicative route

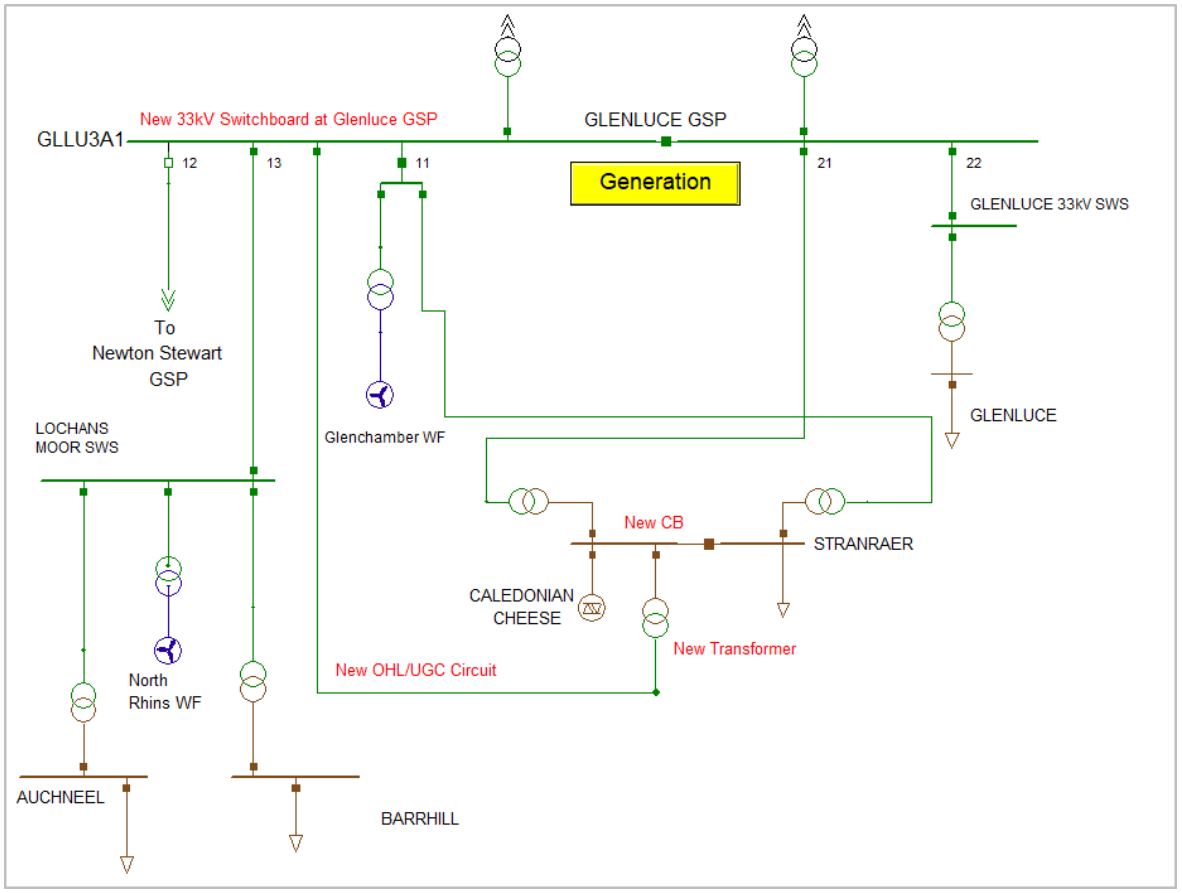

Figure 9. Schematic of Baseline option 33kV network

Based on the response to the flexibility tender run in Spring 2021, flexibility as a viable option to delay reinforcement has been discounted. However, in order to facilitate market growth, manage network

constraints during project delivery and enable network outages, the total of 3.4MW of capacity has been accepted between 2023-2027, which is shown in Table 5.2. The cost of flexibility services has been added to the proposed solution.

Table 5.5. Accepted flexible capacity from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.3	0.6	0.9	1.6	-

Table 5.6 shows a summary of reinforcement costs and volumes for this option under RIIO-ED2.

Table 5.6. Baseline option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV CB (GM) Primary	1	0.028	0.028	-
33kV OHL (Pole Line) Conductor	14.5	0.378	0.378	-
33kV Pole	145	0.434	0.434	-
33kV UG Cable (Non Pressurised)	1.2	0.240	0.240	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	10	1.670	1.670	-
33kV Transformer (GM)	1	0.369	0.369	-
Pilot Wire Overhead	14.5	0.391	0.391	-
Pilot Wire Underground	1.2	0.133	0.133	
Civil Works at 33 kV & 66 kV Substations		0.249	0.249	-
Wayleaves/Easements/Land Purchase		0.121	0.121	-
Other Costs (Identify Below)		0.479	0.479	-
Flexibility		0.051	0.051	
Total Costs		4.541	4.541	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and Design (£100k)				
Environmental consideration (£79k)				
33kV telecoms upgrade (£10k)				
Railway possession (£30)				
RTU/SCADA (£50k)				
Remote End Protection (£210k)				

5.3 Option 2 – Establish a new primary group fed from Glenluce GSP

This option considers installation of the new Stranraer 'B' primary with a 33kV connection to into Glenluce GSP. The option would release 10MVA additional network capacity. It will enable a portion of demand to be offloaded from Stranraer primary, consequently, maintaining voltage compliance.

Table 5.7 shows the scheme summary. This option is rejected based on cost.

Table 5.7. Option 2 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Stranraer Primary Reinforcement	Install new Stranraer 'B' primary	7.143	-

The indicative route of the third 33kV circuit is shown in Figure 10 and Figure 11 shows 33kV network for this option. The existing switchboard comprises Hawker Sidley HG 36 circuit breakers on an air insulated busbar. The existing switchboard cannot be extended any further. It is therefore recommended that a new switchboard is installed, which will replace the existing switchboard at Glenluce GSP, in order to establish the connection of Stranraer 'B'.

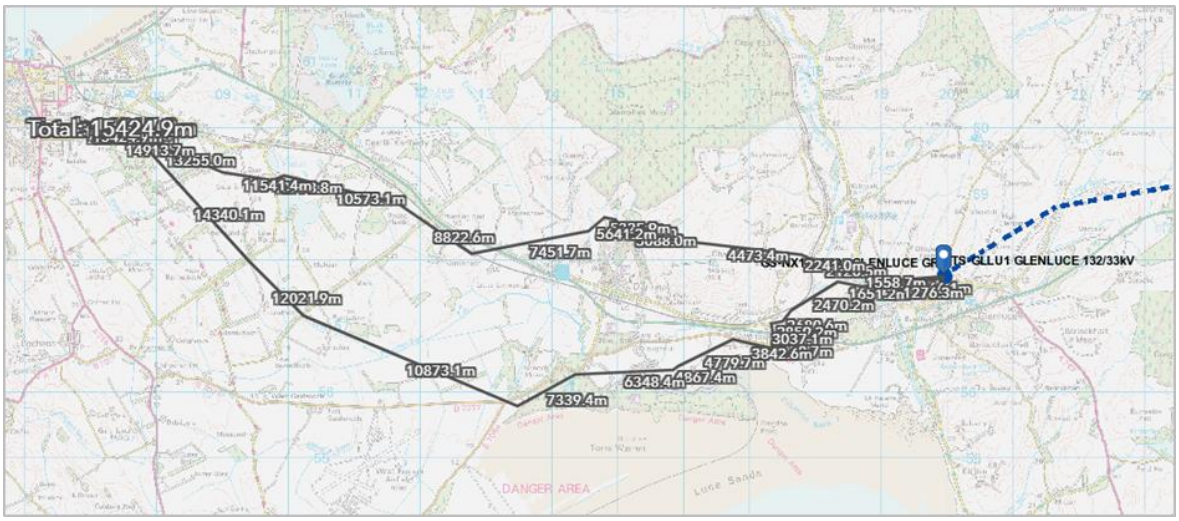

Figure 10. Indicative route

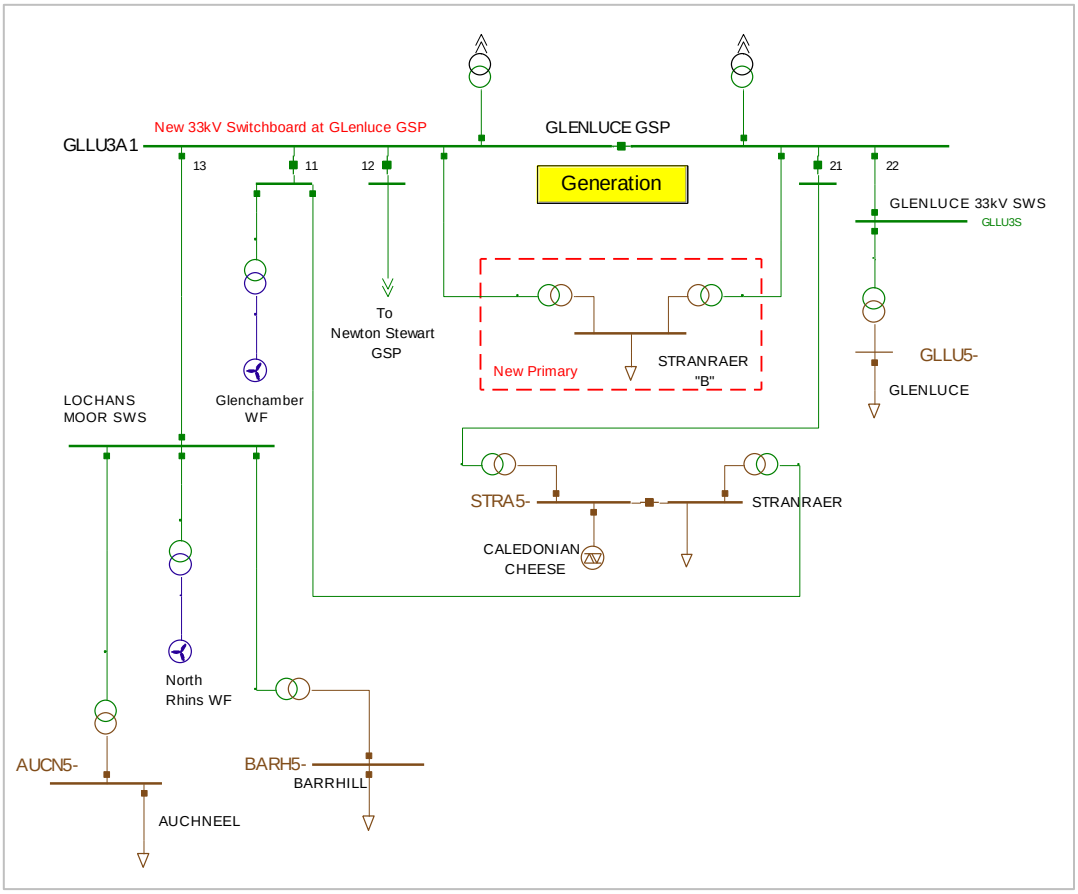

Figure 11. Schematic of Option 2 33kV network

Based on the response to the flexibility tender run in Spring 2021, flexibility as a viable option to delay reinforcement has been discounted. However, in order to facilitate market growth, manage network constraints during project delivery and enable network outages, the total of 3.4MW of capacity has been accepted between 2023-2027, which is shown in Table 5.2. The cost of flexibility services has been added to the proposed solution.

Table 5.8. Accepted flexible capacity from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.3	0.6	0.9	1.6	-

Table 5.9 shows a summary of reinforcement costs and volumes for this option under RIIO-ED2.

Table 5.9. Option 2 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV CB (GM) Primary	7	0.194	0.194	-
33kV OHL (Pole Line) Conductor	29	0.757	0.757	-
33kV Pole	290	0.867	0.867	-
33kV UG Cable (Non Pressurised)	2.4	0.479	0.479	
33kV CB (Gas Insulated Busbars)(ID) (GM)	11	1.837	1.837	
33kV Transformer (GM)	2	0.738	0.738	
Pilot Wire Overhead	29	0.782	0.782	
Pilot Wire Underground	2.4	0.266	0.266	
Civil Works at 33 kV & 66 kV Substations		0.397	0.397	-
Wayleaves/Easements/Land Purchase		0.191	0.191	-
Other Costs (Identify Below)		0.583	0.583	-
Flexibility		0.051	0.051	
Total Costs		7.143	7.143	-
Identify Activities Included Within Other Costs				
Planning and Design (£100k)				
Environmental consideration (£157k)				
33kV telecoms upgrade (£10k)				
Railway Possession (£30k)				
RTU/SCADA (£55k)				
Remote End Protection (£231k)				

5.4 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.10.

Table 5.10. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Install 3rd circuit to Glenluce and replace Glenluce 33kV switchboard	4.541
Option 1	Install a +/- 7.5MVAr STATCOM	2.467
Option 2	Install new Stranraer 'B' primary	7.143

Derivation of costs for these options are based on the SPEN RIIO-ED2 Unit Cost Manual for intervention. This is based on bottom up cost assessment of the components of activity detailed within

the RIGs Annex A for the above activities, SPEN's contractual rates for delivery, market available rates and historic spend levels.

6 Deliverability & Risk

6.1 Preferred Options & Output Summary

The adopted option is Option 1, an innovative solution, to install a new reactive support device at the existing Stranraer Primary substation to mitigate the forecast voltage issues.

6.2 Cost Benefit Analysis Results

A cost benefit analysis (CBA) was carried out to compare the NPV of the options discussed in the previous sections. Considering the lowest forecast capital expenditure, the proposed option has the highest total NPV. The summary of the cost benefit analysis is presented in Table 6.1. The full detailed CBA is provided within 'ED2-LRE-SPD-024-CV1-CBA – Stranraer Primary Reinforcement'.

Table 6.1. Cost benefit analysis results

Options considered	Decision	Comment	NPVs based on payback periods, £m (2020/21 prices)			
			10 years	20 years	30 years	45 years
Baseline – Install 3rd circuit to Glenluce and replace Glenluce 33kV switchboard	Rejected	Discounted on NPV				
Option 1 – Install a +/- 7.5MVAr STATCOM	**Adopted**		0.94	1.39	1.66	1.87
Option 2 – Install new Stranraer 'B' primary	Rejected	Discounted on NPV	-1.17	-1.74	-2.07	-2.34

6.3 Cost & Volumes Profile

Table 6.2 shows the breakdown of expenditure for the proposed scheme (in 2020/21 prices) and the cost incidence (in 2020/21 prices) over the RIIO-ED2 period is shown in Table 6.3. The total cost of the proposed scheme is £2.467m.

Table 6.2: Summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	0.3	0.035	0.035	-
6.6/11kV CB (GM) Primary	2	0.055	0.055	-
Pilot Wire Underground	0.3	0.033	0.033	-
Civil Works at 33 kV & 66 kV Substations		0.122	0.122	-
Other Costs (Identify Below)		2.170	2.170	-
Flexibility		0.051	0.051	
Total Costs		2.467	2.467	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Installation of +/-7.5MVAr STATCOM (£2m)				
Planning and Design (£100k)				
Environmental consideration (£10k)				
33kV telecoms upgrade (£30k)				
Remedial works on the existing site (£30k)				

Table 6.3: Cost incidence over the RIIO-ED2 period, £m (2020/21 Prices)

Total Investment	Total (£m)	Incidence (£m)				
		2023/24	2024/25	2025/26	2026/27	2027/28
CV1 (Primary Reinforcement)	**2.416**	-	-	0.242	1.208	0.966
CV1 (Flexible Service)	**0.051**	0.002	0.005	0.011	0.032	-
Total Cost	**2.467**	**0.002**	**0.005**	**0.253**	**1.240**	**0.966**

6.4 Risks

Currently, there is no STATCOM installed on our network. Therefore, there is a risk associated with the installation, operation and maintenance of the assets. However, this risk is very low as STATCOM has a technology reediness level of 9 (TRL9) and we are developing plans to deliver training to the relevant staff.

6.5 Outputs Included in RIIO-ED1 Plans

There are no outputs expected to be delivered in RIIO-ED1 that are funded within this proposal.

6.6 Future Pathways – Net Zero

6.6.1 Primary Economic Driver

The primary driver for this investment is to maintain network voltages within statutory limits defined in the ESQCR, Distribution Code and EREC P28. The investment does not have a strong reliance on environmental benefits.

6.6.2 Payback Periods

The CBA indicates that for the proposed option demonstrates better NPV results in all assessment periods (10, 20, 30 & 45 years) against other two options. As the intervention is forecast to carry at least a 45-year asset life expectancy, the CBA at this time justifies the intervention. Consumers will also benefit from reduced network risk immediately on completion of the project.

6.6.3 Sensitivity to Future Pathways

The network capacity and capability that result from the proposed option is consistent with the network requirements determined in line with the section 9 of the Electricity Act and Condition 21. Additionally, the proposed option is consistent with the SPEN's Distribution System Operator (DSO) Strategy and Distribution Future Energy Scenarios.

Table 6.4 shows electric vehicle and heat pump uptakes across a range of future pathways and Table 6.5 shows the sensitivity of the proposed solution and Table 6.6 shows the sensitivity of the proposed RIIO-ED2 expenditure against the full ranges of Net Zero complaint future pathways other Climate Change Committee (CCC) scenarios.

Table 6.4: Electric Vehicle and Heat Pump uptakes across a range of future pathways

End of RIIO-ED2	SPEN	DFES			CCC				
	Baseline	System Transformation*	Consumer Transformation	Leading the Way	Balanced Net Zero Pathway	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
EVs	1,153		1,212	1,457	1,383	952	1,505	1,371	1,371
HPs	775		826	1,314	666	556	756	683	653

** Note: We have excluded System Transformation from our future pathways assessment as it does not meet interim greenhouse gas emission reduction targets.*

Table 6.5: Sensitivity of the proposed solution against future pathways

	RIIO-ED1				RIIO-ED2					RIIO-ED3				
Solution Requirements	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Baseline									S1					
Consumer Transformation								S2						
Leading the Way									S1					
Balanced Net Zero Pathway									S1					
Headwinds										S1				
Widespread Engagement								S2						
Widespread Innovation								S2						
Tailwinds									S1					

S1 – Install +/-7.5MVAr STATCOM at Stranraer
S2 – Install +/-10MVAr STATCOM at Stranraer

The proposed solution is robust across a wide range of pathways.
A STATCOM is the right solution for every pathway, installing a STATCOM is a robust choice across different decarbonisation pathways. The size of the STATCOM (7.5MVAr or 10MVAr) and the timing of when it is required (2027-2029) is sensitive to the different decarbonisation pathways. If customer growth is higher than our baseline scenario, we will be prepared to install a larger STATCOM earlier in the period than in our baseline plan. The additional funding of +£0.50m needed for the larger STATCOM would need to be recovered through an uncertainty mechanism. The RIIO-ED2 regulatory framework will need to allow DNOs' allowances to flex in response to higher uptakes.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	**Uncertain**
RIIO-ED2 Expenditure (£m)	2.467	+0.500
Comment	Proposed option.	Under higher uptake scenarios a larger STATCOM may be required.

6.6.4 Asset Stranding Risks & Future Asset Utilisation

Electricity demand and generation loadings are forecast to increase under all scenarios. The stranding risk is therefore considered to be low.

6.6.5 Losses / Sensitivity to Carbon Prices

Losses have been considered in accordance with Licence Condition SLC49 and the SP Energy Networks Losses Strategy and Vision to "consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers". Reasonable design efforts have been taken to minimise system losses without detriment to system security, performance, flexibility or economic viability of the scheme. This includes minimising conductor lengths/routes, the choice of appropriate conductor sizes, designing connections at appropriate voltage levels and avoiding higher impedance solutions or network configurations leading to higher losses.

Losses have not been evaluated as part of optioneering the optimum solution for the scheme. As the proposed scheme involves reactive compensation equipment which is primarily to support the voltage issues in the grid group, the impact of the voltage support on the network losses involves a complex network analysis. As such. the detailed losses assessment will be carried out during the design stage of the proposed. scheme.

During the evaluation of the options associated with the proposed scheme, we have embedded within the CBA, where data are available, an assessment of the embodied carbon and the associated carbon cost to inform our NPV evaluation. The mass of carbon dioxide emitted (CO2e) during the manufacture of the main equipment deployed to deliver this scheme is estimated to be 6.9 tonnes. The monetised embodied carbon value associated with this emission is £0.46k. It should be noted that the embodied carbon evaluation undertaken has only considered the manufacture and supply of materials. Further collaborative industry-wide work is planned for the RIIO-ED2 price review period to better understand the overall embodied carbon values including, for example installation and commissioning services, decommissioning and disposal activities as well as refurbishment opportunities. More information regarding this can be found in Section 3.1.2 of our Environmental Action Plan[2].

6.6.6 Whole Systems Benefits

Whole system solutions have been considered as part of this proposal. No alternatives have been identified that could be provided through a whole systems solution. The completion of this scheme will maintain the integrity of the distribution network and its enduring ability to facilitate wider whole system benefits.

6.7 Environmental Considerations

6.7.1 Operational and Embodied Carbon Emissions

The Stranraer Primary Reinforcement programme has the potential to impact on the embodied carbon resulting from the delivery of the programme. There is likely to be limited impact on SPEN's Business Carbon Footprint (BCF).

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts associated of the Stranraer Primary Reinforcement, we need access to reliable data from our suppliers. The need for carbon and other sustainability credentials to be provided now forms part of our wider sustainable procurement policy.

6.7.3 Resource Use and Waste

The Stranraer Primary Reinforcement programme will result in the consumption of resources and the generation of waste materials from end of life assets.

Where waste is produced it will be managed in accordance with the waste hierarchy which ranks waste management options according to what is best for the environment. The waste hierarchy gives top priority to preventing waste in the first instance, then preparing for re-use, recycling, recovery, and last of all disposal (e.g. landfill).

[2] Annex 4C.3: Environmental Action Plan, SP Energy Networks, Issue 2, 2021.

6.7.4 Biodiversity / Natural Capital

The Stranraer Primary Reinforcement programme will only affect a single named site containing existing assets. Therefore, the impact on, and the opportunity to improve biodiversity and natural capital is expected to be minimal.

6.7.5 Preventing Pollution

SPEN will always follow all relevant waste regulations and will make sure that special (hazardous) waste produced or handled by our business is treated in such a way as to minimise any effects on the environment.

6.7.6 Visual Amenity

SPEN continually seeks to reduce the landscape and visual effects of our networks and assets but recognises that the nature of our substations makes it challenging to minimise their visual impact. Our use of underground cables instead of overhead lines helps to minimise our overall visual impact.

6.7.7 Climate Change Resilience

In addition to our efforts to minimise our direct carbon emissions in line with our Net Zero ambitions, we are also conscious of the need to secure the resilience of our assets and networks in the face of a changing climate. We have also modified our policy on vegetation control in the face of higher temperatures and longer growing seasons.

7 Conclusion

The Stranraer primary substation is supplied via long 33kV overhead line circuits (14km and 15.5km). Studies indicate that due to the long circuit lengths, the forecast additional demand growth and LCT uptake in RIIO-ED2 through RIIO-ED3 will lead to steady state undervoltage and voltage step issues beyond operational management.

In order to maintain the steady state voltage of the 33kV network to within +/- 6% of the declared voltage under the ESQCR 2002 and maintain voltage step within +/- 10%, an innovative reactive power compensation scheme is proposed in terms of installation of a ±7.5MVAr STATCOM at Stranraer primary.

The proposed solution represents the lowest cost and is an efficient solution to meet the forecast demand growth when compared with the identified alternative scheme.

Flexibility services have been procured to reduce the network risk through the delivery stage at a cost of £51k. We will continue to tender for flexibility services in this area in order to test the market for technically compliant flexibility solutions to resolve this complex voltage constraint.

Demand is forecast to remain below the firm capacity until 2028. Therefore, it is proposed to start the works in 2025/26, with completion in 2027/28. A capacity release of 7.8MVA will be claimed in 2027/28 at the end of the project. The estimated cost for the above is £2.467m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.