33kV Circuit Upgrades

ED2 Engineering Justification Paper

ED2-LRE-SPD-023-CV1-EJP

Issue	Date	Comments
Issue 0.1	Apr 2021	Issue to internal governance and external assurance
Issue 0.2	May 2021	Reflecting comments from internal governance and 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	33kV Circuit Upgrades		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-023-CV1		
Output	Load Index		
Cost	£0.549m		
Delivery Year	2026-2028		
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	**£0.549m**	**£m**

SP ENERGY NETWORKS

SP ENERGY NETWORKS

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:	**33kV Circuit Upgrades**
Project Reference:	**ED2-LRE-SPD-023-CV1**
Decision Required:	**To give concept approval to overlay sections of underground cable and re-string sections of overhead lines that are forecast to be thermally overloaded within the RIIO-ED2 period.**

Summary of Business Need:

A review of SP Distribution (SPD) overhead line (OHL) and underground cable (UGC) database has identified demand groups, served by assets, with thermal ratings below the firm capacity of the group. All sites were analysed against Distribution Future Energy Scenarios (DFES). From the identified sites, four demand groups: Commercial Rd, Larbert, Troon and St Ninians Cornhill are forecast to exceed their thermal rating by the end of RIIO-ED2 under our Baseline View.

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

This engineering justification paper proposes to overlay sections of underground cable and re-string sections of overhead lines that are forecast to be thermally overloaded within the RIIO-ED2 period. The proposed works will increase the firm capacity of the following four primary substations: Commercial Rd primary, Larbert primary, Troon primary and St Ninians Cornhill primary.

The estimated cost for the above is £0.549m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. This relatively low capital expenditure will provide a 22.06MVA capacity uplift, spread across four identified demand groups.

Flexibility services were sought as a solution to delay reinforcement. 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 and reduce risk during delivery, flexibility services have been accepted at the constrained demand groups (1.5MW at Troon primary, 2.8MW at Larbert primary, 2.3MW at St Ninians primary and 2MW at Commercial Road primary).

Expenditure Forecast (in 2020/21)

Licence Area	Reporting Table	Description	Total (£m)	Incidence (£m)				
				2023/24	2024/25	2025/26	2026/27	2027/28
SPD	CV1	Primary Reinforcement	**0.537**	-	-	-	-	0.537
SPD	CV1	Flexible Service	**0.012**	0.000	0.001	0.010	-	
SPD	**Total**		**0.549**	**0.000**	**0.001**	**0.010**	**-**	**0.537**

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

A review of SP Distribution (SPD) overhead line (OHL) and underground cable (UGC) database has identified demand groups, served by assets, with thermal ratings below the firm capacity of the group. Following the review, the firm capacities of the identified demand groups have been adjusted to reflect new data. All sites were analysed against Distribution Future Energy Scenarios (DFES) for future constraints. From the identified sites, four demand groups: Commercial Rd, Larbert, Troon and St Ninians Cornhill, are forecast to exceed their firm capacity within the RIIO-ED2 price control under our Baseline View.

In order to secure supplies within the group, meet the licence obligations under EREC P2/7 – Security of Supply and to accommodate future demand growth within the area, it is proposed to overlay and re-string each sections of circuit within the RIIO-ED2 period.

Flexibility services were sought as a solution to delay reinforcement. 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 and reduce risk during delivery, flexibility services have been accepted at the constrained demand groups (1.5MW at Troon primary, 2.8MW at Larbert primary, 2.3MW at St Ninians primary and 2MW at Commercial Road primary).

The estimated cost for the above is £0.549m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

It is recommended to continue annual tendering for flexibility in this area to procure enough capacity. The proposed solution will be reviewed depending on procuring enough capacity in the future tenders.

The baseline view forecasts an operationally manageable level of demand during the first four years of RIIO-ED2. For that reason, it is proposed to do the works in 2027/28, with a capacity of 22.06MVA released in the same year upon completion of the proposed works.

2 Background Information

2.1 Existing / Authorised Network

Commercial Rd primary is fed from Hawick Grid Supply Point (GSP) via two 33kV OHL/UGC circuits. The minimum rated section of the circuits feeding Commercial Rd primary has a winter cyclic thermal rating of 13.5MVA. The group is served by two 24MVA, Hawker Siddley, 33/11kV transformers (1971). The firm capacity (N-1) of Commercial Rd primary is 13.5MVA. Existing 33kV network feeding Commercial Rd primary is shown in Figure 1.

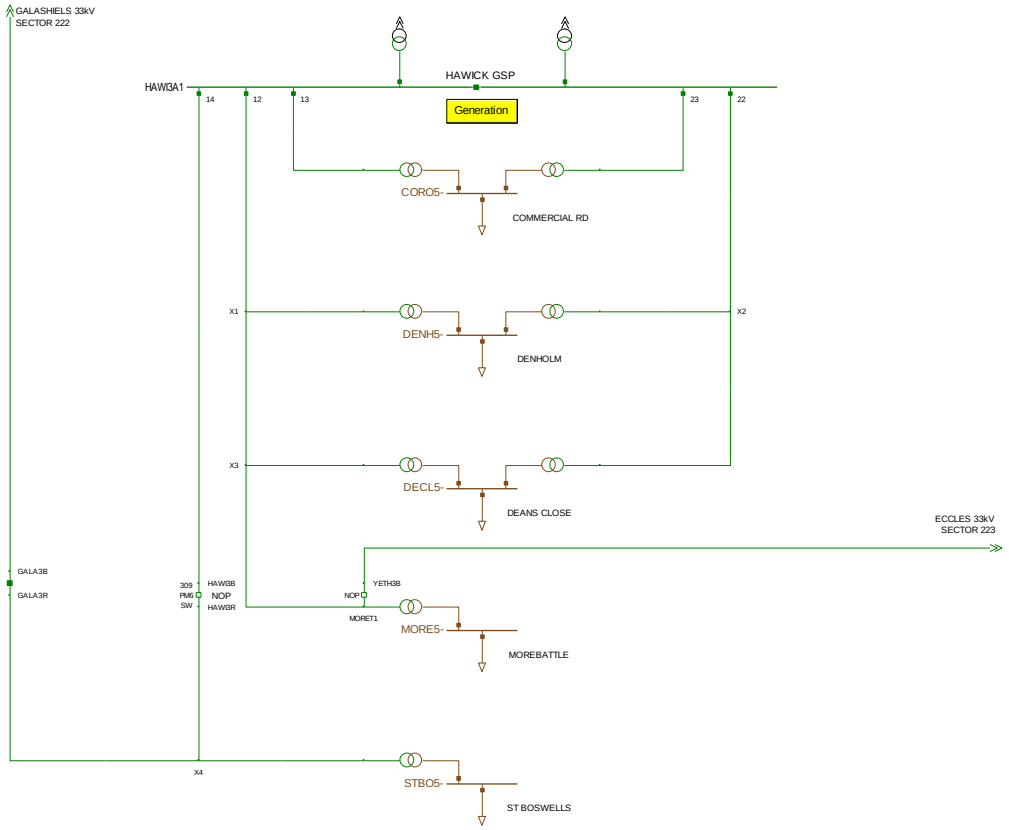

Figure 1. Existing 33kV network feeding Commercial Rd primary

Larbert primary is fed from Bonnybridge GSP via two 33kV OHL/UGC circuits. The minimum rated section of the circuits feeding Larbert primary has a winter cyclic thermal rating of 16.3MVA. The group is served by two 21MVA, SMIT, 33/11kV transformers (2001/02). The firm capacity (N-1) of Larbert primary is 16.3MVA. Existing 33kV network feeding Larbert primary is shown in Figure 2.

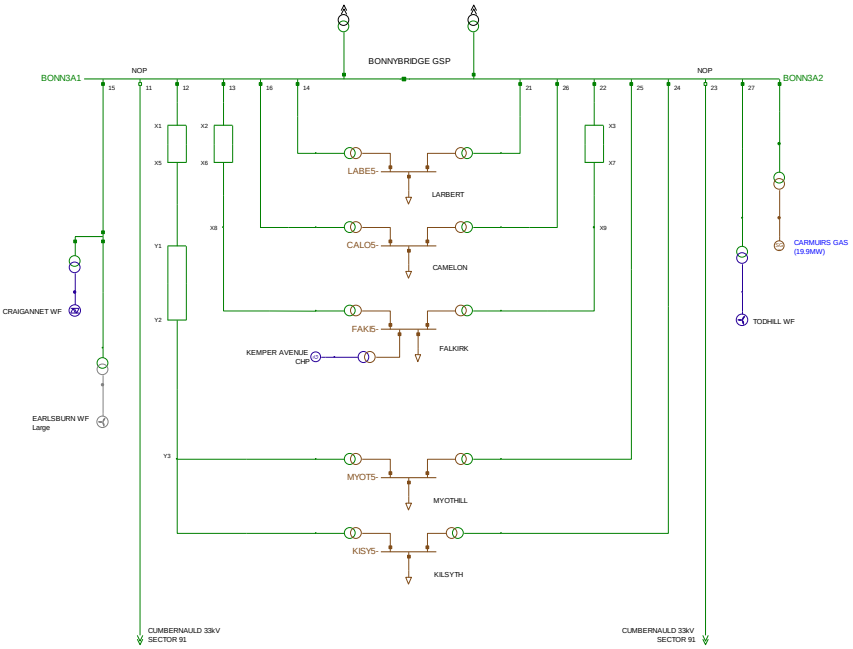

Figure 2. Existing 33kV Network feeding Larbert primary

Troon primary is fed from Kilmarnock Town GSP via two 33kV OHL/UGC circuits. The circuit feeding Troon primary T1 is banked onto a 33kV interconnectable circuit between Kilmarnock Town GSP and Kilwinning GSP. The minimum rated section of the circuits feeding Troon has a winter cyclic thermal rating of 17.4MVA. The group is served by two 24MVA, Brush, 33/11kV transformers (2017/18). The firm capacity (N-1) of Troon Primary is 17.4MVA. Existing 33kV network feeding Troon primary is shown in Figure 3.

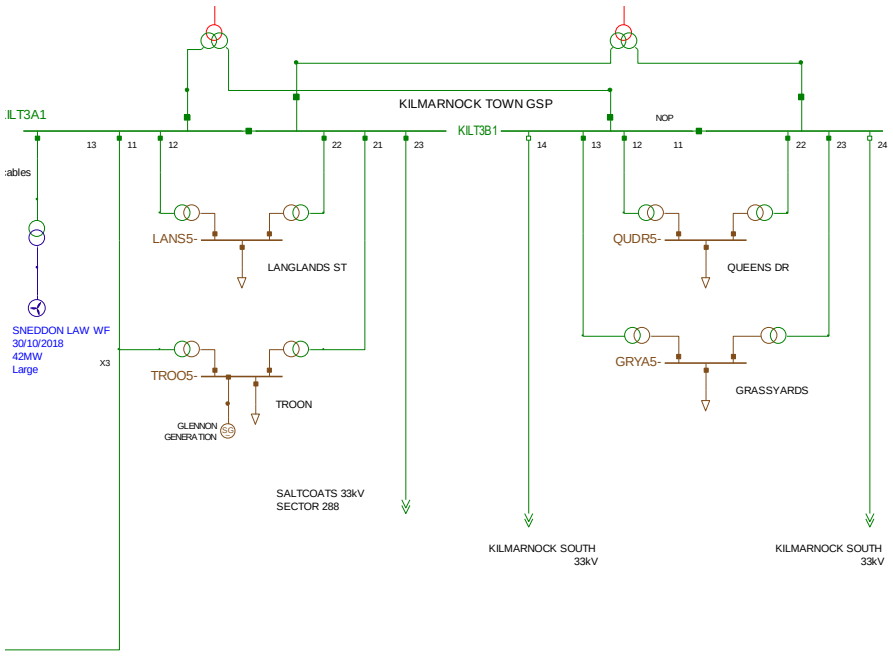

Figure 3. Existing 33kV Network feeding Troon primary

St Ninians Cornhill primary is fed from Stirling GSP via two 33kV OHL/UGC circuits. The minimum rated section of the circuits feeding St Ninians Cornhill primary has a winter cyclic thermal rating of 17.4MVA. The group is served by two 24MVA, Bruce Peebles, 33/11kV transformers. The firm capacity (N-1) of St Ninians Cornhill primary is 17.4MVA. Existing 33kV network feeding St Ninians Cornhill primary is shown in Figure 4.

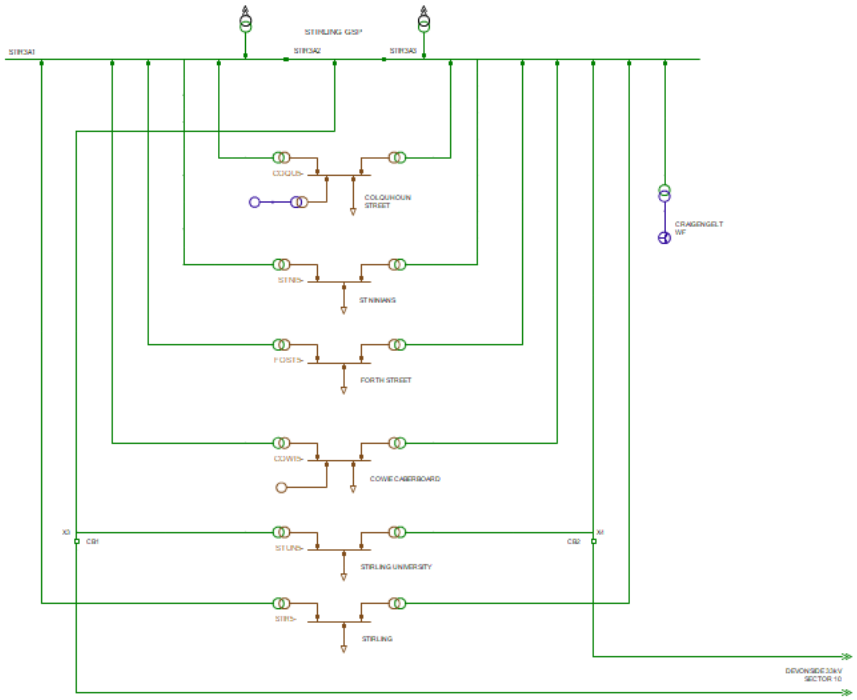

Figure 4. Existing 33kV Network feeding St Ninians Cornhill primary

2.2 Group Demand & Security of Supply

All the identified primary substations feed demand groups with a demand between 12-60MW. A demand in this range places the group in a class 'C' of supply as per ENA Engineering Recommendation (EREC) P2/7 and must be secured for a first circuit outage (FCO). The existing group demands are shown in Table 2.1.

Table 2.1. Commercial Rd, Larbert, Troon and St Ninians Cornhill group demands (2020 Load Index)

Demand Group	Customers (#)	Firm Capacity (MVA)	Max Demand (MVA)	Load Index	P2/7 Class of Supply
Commercial Rd	9,034	13.5	12.8	LI2	C
Larbert	8,284	16.3	15.2	LI2	C
Troon	9.720	17.4	16.6	LI3	C
St Ninians Cornhill	11,690	17.4	13.8	LI1	C

2.3 Embedded Generation

There is no embedded generation connected to Commercial Rd 11kV network. Embedded generation connected to Larbert, Troon and St Ninians Cornhill primary substations is shown in Table 2.2.

Table 2.2. Embedded generation connected to Larbert, Troon and St Ninians Cornhill primary substations

Primary	Voltage (kV)	Site	Capacity (MW)	Type	Status
Larbert	11/LV	Embedded generation (<1MW)	1.1	Onshore Wind	Connected
Troon	11	Glennon Generation	2.3	Waste Incineration (not CHP)	Connected
St Ninians Cornhill	11/LV	Embedded generation (<1MW)	1.8	Onshore Wind/Solar/Hydro	Connected

2.4 Fault Levels

Studies indicate that there are no fault level issues at Commercial Rd, Larbert, Troon and St Ninians Cornhill primary substations.

3 Needs Case

Commercial Rd Primary

Our Baseline View forecasts a peak demand of 14.3MVA by 2028 with an expected uptake of up to 1,185 electrical vehicles and 1,014 heat pumps. This exceeds the Commercial Rd primary firm capacity of 13.5MVA within the RIIO-ED2 period.

Larbert Primary

Our Baseline View forecasts a peak demand of 17.8MVA by 2028 with an expected uptake of up to 2,878 electrical vehicles and 992 heat pumps. This exceeds the Larbert primary firm capacity of 16.3MVA within the RIIO-ED2 period.

Troon Primary

Our Baseline View forecasts a peak demand of 18.4MVA by 2028 with an expected uptake of up to 2,957 electrical vehicles and 992 heat pumps. This exceeds the Troon primary firm capacity of 17.4MVA within the RIIO-ED2 period.

St Ninians Cornhill Primary

Our Baseline View forecasts a peak demand, by 2028, of 19.6MVA, with an expected uptake of up to 3,163 electrical vehicles and 2,012 heat pumps. This exceeds the St Ninians Cornhill primary firm capacity of 17.4MVA within the RIIO-ED2 period.

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 forecasts based on the SPD Distribution Future Energy Scenarios at each of the four demand groups are depicted in Figure 5, Figure 6, Figure 7 and Figure 8. The anticipated total

electric vehicle and heat pump uptakes based on the future energy scenarios at each of the four demand groups are depicted in Figure 9, Figure 10, Figure 11 and Figure 12.

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.

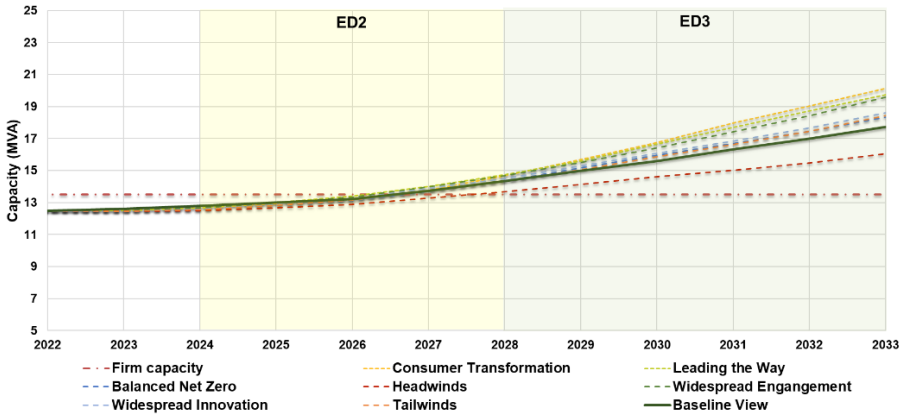

Figure 5. Demand (MVA) forecast for Commercial Rd demand group

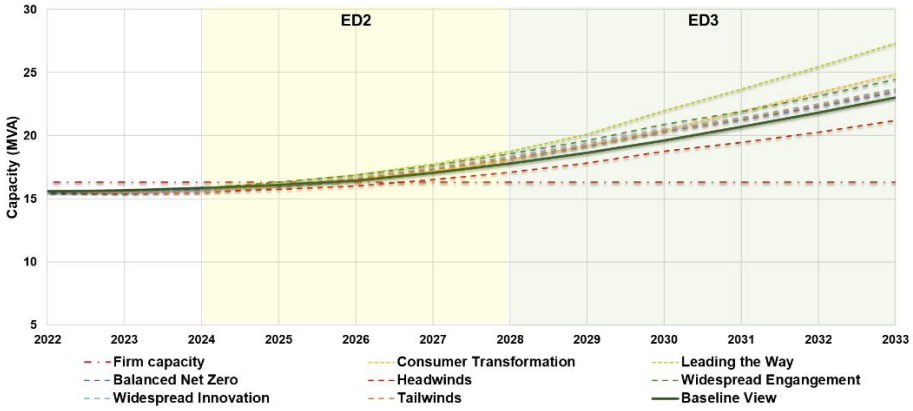

Figure 6. Demand (MVA) forecast for Larbert demand group

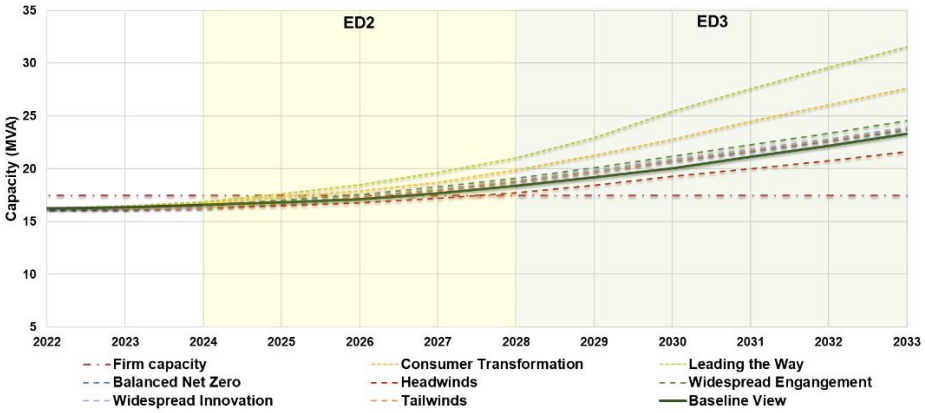

Figure 7. Demand (MVA) forecast for Troon demand group

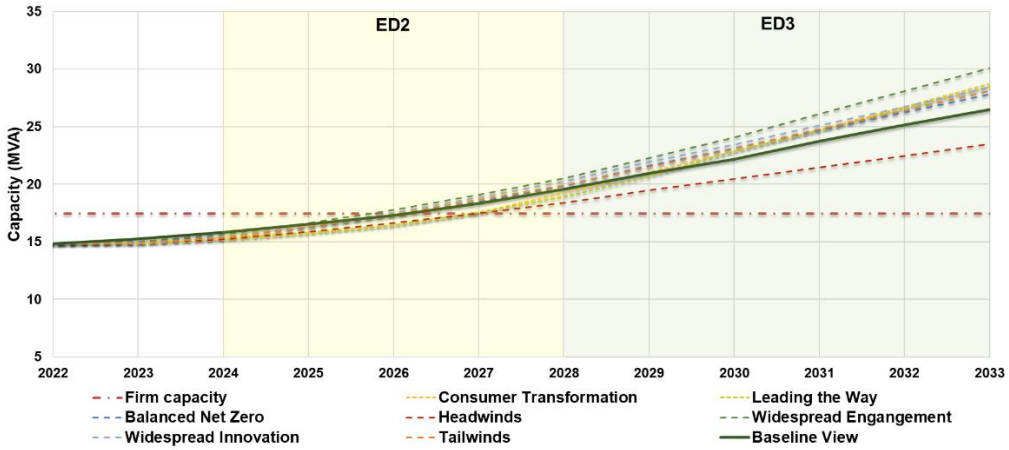

Figure 8. Demand (MVA) forecast for St Ninians Cornhill demand group

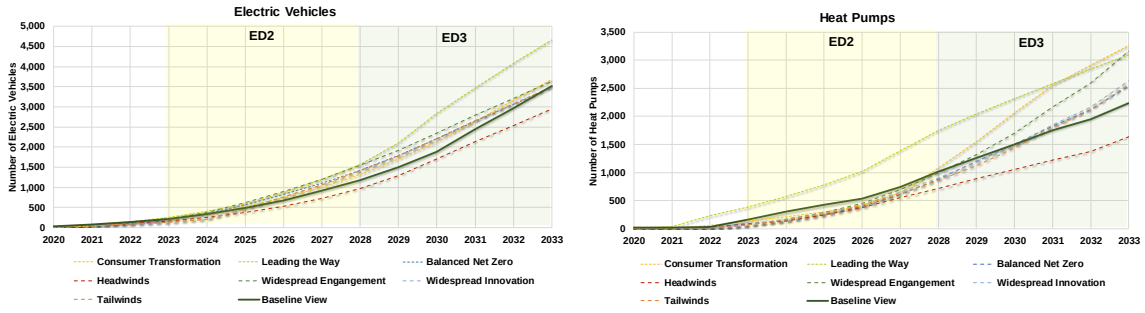

Figure 9. Forecast Electric Vehicle and Heat Pump uptakes for Commercial Rd demand group

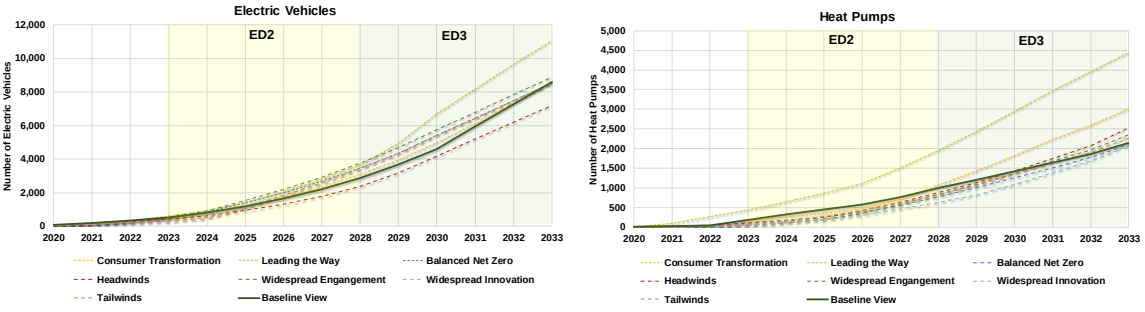

Figure 10. Forecast Electric Vehicle and Heat Pump uptakes for Larbert demand group

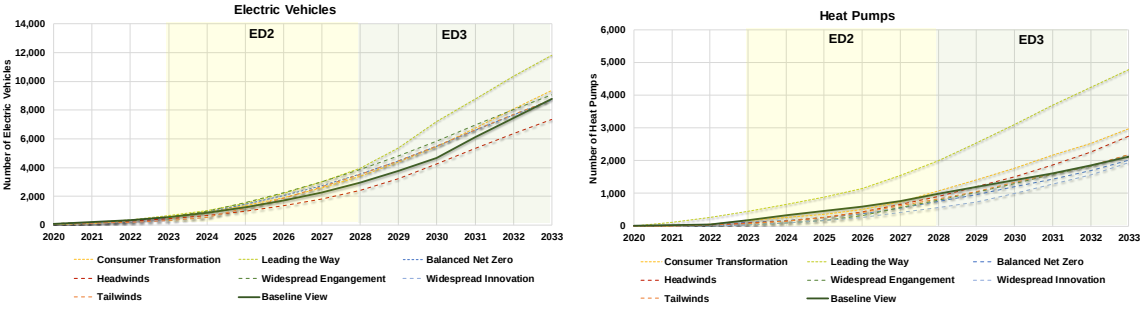

Figure 11. Forecast Electric Vehicle and Heat Pump uptakes for Troon demand group

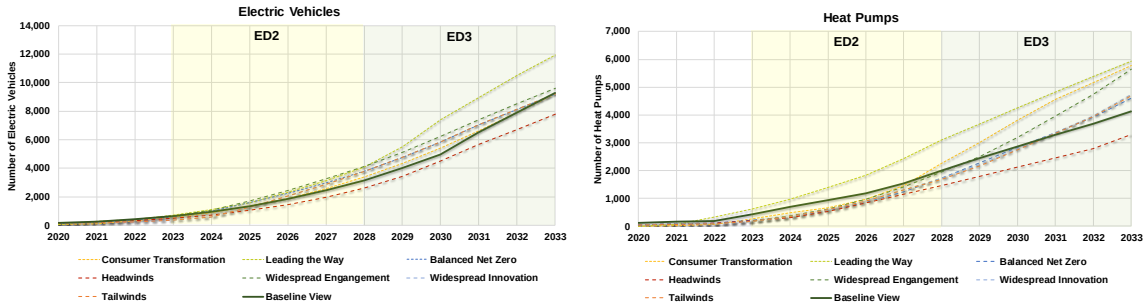

Figure 12. Forecast Electric Vehicle and Heat Pump uptakes for St Ninians Cornhill demand group

3.1.2 Baseline View

For each of the four demand groups, the forecast demand growth under our Baseline scenarios, along with the firm capacities and utilisation through to RIIO-ED3 period are shown in Table 3.1, Table 3.2, Table 3.3 and Table 3.4.

Table 3.1. Baseline View forecast for Commercial Rd primary

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	12.5	12.6	12.8	13.0	13.2	13.7	14.3	15.0	15.6	16.3	17.0	17.7
Firm Capacity (MVA)	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5
Utilisation (%)	92	93	95	96	98	102	106	111	115	121	126	131
Load Index	LI2	LI2	LI2	LI3	LI3	LI4	LI5	LI5	LI5	LI5	LI5	LI5

Table 3.2. Baseline View forecast for Larbert primary

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	15.6	15.6	15.8	16.1	16.4	17.0	17.8	18.7	19.6	20.7	21.8	23.0
Firm Capacity (MVA)	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
Utilisation (%)	96	96	97	99	101	105	109	115	120	127	134	141
Load Index	LI3	LI3	LI3	LI3	LI4	LI4	LI5	LI5	LI5	LI5	LI5	LI5

Table 3.3. Baseline View forecast for Troon primary

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	16.2	16.3	16.6	16.8	17.1	17.7	18.4	19.2	20.0	21.1	22.2	23.3
Firm Capacity (MVA)	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
Utilisation (%)	93	94	95	96	98	101	105	110	115	121	127	134
Load Index	LI2	LI2	LI2	LI3	LI3	LI4	LI5	LI5	LI5	LI5	LI5	LI5

Table 3.4. Baseline View forecast for St Ninians Cornhill primary

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	14.8	15.2	15.8	16.5	17.3	18.3	19.6	21.0	22.1	23.7	25.1	26.5
Firm Capacity (MVA)	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
Utilisation (%)	85	87	91	95	99	105	112	120	127	136	144	152
Load Index	LI2	LI2	LI2	LI2	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 each of the four demand groups considering the different demand forecast scenarios.

The network thermal constraint during the most onerous outage was identified and time profile-based simulations (17,520 half-hourly simulations/year) were performed considering the historical half hourly measured Supervisory control and data acquisition (SCADA) data at primary substation overlaid with the DFES demand forecasts for each year through the RIIO-ED2 price control period. These studies identify the risk in terms of the thermal capacity exceedances with the forecast demand, the anticipated annual hours at risk and risk window of the constraint. The half-hourly studies performed for years starting from 2023 through 2028 determined the risk hours and the capacity required to overcome the constraint by using flexibility services.

3.2.1 Thermal Constraints

Table 3.5 shows the identified thermal constraints on the 33kV network level at each of the four demand grops.

Table 3.5. Thermal constraints at 33kV level

Network Item	Voltage	Outage
Hawick GSP to Commercial Rd primary No.1 cct	33kV	N-1
Bonnybdirge GSP to Larbert primary No.1 cct	33kV	N-1
Kilmarnock Town GSP to Troon primary No.1 cct	33kV	N-1
Stirling GSP to St Ninians Cornhill primary No.2 cct	33kV	N-1

3.2.2 Voltage Constraints

There were no voltage constraints at 11kV network fed from each of the four demand groups.

3.2.3 EREC P2/7 – Security of Supply

Commercial Rd primary substation has a forecast peak demand of 14.3MVA by the end of RIIO-ED2. Larbert primary substation has a forecast peak demand of 17.8MVA by the end of RIIO-ED2. Troon primary substation has a forecast peak demand of 18.4MVA by the end of RIIO-ED2. St Ninians Cornhill primary substation has a forecast peak demand of 19.6MVA by the end of RIIO-ED2. Engineering Recommendation (EREC) P2/7 defines all those group demands as a class 'C' of supply.

EREC P2/7 states that a group demand with a class 'C' of supply must secure the following minimum demand for a first circuit outage (FCO):

- Smaller of group demand minus 12MW; and 2/3 of group demand;
- Group demand must be met within 3 hours.

Commercial Rd group demand has an FCO security of 13.5MVA. Larbert group demand has an FCO security of 16.3MVA. Troon group demand has an FCO security of 17.4MVA. St Ninians Cornhill group demand has an FCO security of 17.4MVA. Therefore, all four sites are predicted to be non-compliant under EREC P2/7 by the end of the RIIO-ED2 price control period; consequently, investment is required.

3.2.4 Flexibility Services

In order to manage the network risk on the 11kV network, our assessment indicates that the risk of thermal overload, for the most onerous scenario including an additional 5% for the asset protection margin, starts from the year 2023/24 throughout to the year 2028 for Commercial Rd and Larbert demand groups and from the year 2023/24 throughout to the year 2028 for Troon and St Ninians Cornhill demand groups. These are shown Table 3.6, Table 3.7, Table 3.8 and Table 3.9. The detailed results from the half hourly profile-based simulations are furnished in Appendix 1.

Table 3.6. Network annual hours at risk and flexible capacity tendered in Spring 2021 for Commercial Rd primary

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	4	13	29	91	317
Required Flexible Capacity (MW)	0.19	0.61	0.95	1.80	2.81

Table 3.7. Network annual hours at risk and flexible capacity tendered in Spring 2021 for Larbert primary

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	2	7	44	193	412
Required Flexible Capacity (MW)	0.32	0.80	1.36	2.14	3.05

Table 3.8. Network annual hours at risk and flexible capacity tendered in Spring 2021 Troon primary

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	-	4	34	118	255
Required Flexible Capacity (MW)	-	0.40	0.91	1.63	2.46

Table 3.9. Network annual hours at risk and flexible capacity tendered in Spring 2021 for St Ninians Cornhill primary

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	-	5	20	93	296
Required Flexible Capacity (MW)	-	0.68	1.64	2.97	4.63

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 security of supply requirements as per EREC P2/7.
(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)	Overlay/re-string lower rated sections of circuit, delaying £8.183m of investment until RIIO-ED3.	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	Overlay/re-string full 33kV feeder circuits to Commercial Rd, Troon, St Ninians and Larbert Primaries.	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Utilise flexibility services to defer reinforcement into RIIO-ED3	Rejected	Discounted due to insufficient flexibility capacity received to remain EREC P2/7 compliant.
(f)	Install active network management (ANM) on the 11kV network to enable dynamic transfer of demand between substations.	Rejected	Due to increasing demand and projected Low Carbon Technologies uptake, neighbouring groups and the local HV network is reaching capacity. Consequently, insufficient transfer capacity is available.
(g)	Real Time Thermal Rating (innovation).	Rejected	Loading on affected assets is beyond the capacity release realised from RTTR. This option is not technically viable and has been discounted.

5 Detailed Analysis & Costs

5.1 Proposed Option (Baseline) – Overlay/re-string Lower Rated Sections of Circuit

The proposed solution for each of the four identified schemes is to overlay and re-string sections of circuit. The circuit will be overlaid with UGC or re-strung with OHL of a higher thermal rating than the forecast demand. The works will increase the firm capacity of the following primary substations, with minimal capital expenditure:

- Commercial Rd primary
- Larbert primary
- Troon primary
- St Ninians Cornhill primary

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)
Conventional	33kV Circuit Upgrades	Overlay/re-string lower rated sections of circuit	0.549	-

The baseline option represents the "Do Minimum" investment strategy and defers £8.183m of load related reinforcement into RIIO-ED3. The deferred capital expenditure has been added to the CBA, from 2030 to 2033, to reflect the results of the sensitivity analysis discussed in section 6.6.3.

Commercial Rd Primary

Commercial Rd primary is fed from Hawick GSP via two 33kV circuits comprising a combination of OHL and UGC. The firm capacity of the group is set by the lowest rated section of these two circuits. The circuit between Hawick GSP 3A1 and Commercial Road primary T1 has a small section (0.2km) of 0.1ins copper (Cu) underground cable. This small section of circuit limits the firm capacity of the group to 13.5MVA, based on a winter, cyclic, thermal rating. The next lowest rated section of circuit has a thermal rating of 21.8MVA. The proposed solution is to overlay the 0.1ins Cu UGC with 240mm Aluminium (Al) cross-linked polyethylene (XLPE) UGC, which has a winter, cyclic, thermal rating of 26.7MVA. The proposed works would provide a capacity uplift of 8.3MVA, allowing forecast demand growth and Low Carbon Technologies (LCT) uptake with minimal intervention and capital expenditure. This is an enduring solution, providing thermal headroom beyond RIIO-ED3.

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, the total of 2MW of capacity has been accepted between 2023-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.2. Accepted flexible capacity at Commercial Rd primary 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	0.7	1.0	-	-

Larbert Primary

Larbert primary is fed from Bonnybridge GSP via two 33kV circuits comprising a combination of OHL and UGC. The firm capacity of the group is set by the lowest rated section of these two circuits. The circuit between Bonnybridge GSP 3A1 and Larbert Primary T1 has a small section of 185mm Al underground cable. This small section of circuit limits the firm capacity of the group to 16.3MVA, based on a winter, cyclic, thermal rating. The next lowest rated section of circuit is 2.6km of 100mm aluminium conductor steel reinforced OHL, which has a summer/winter (multi circuit) thermal rating of 16.2/20MVA. The proposed solution is to overlay the UGC with 400mm Al XLPE UGC, which has a winter, cyclic, thermal rating of 31.1MVA and re-string the OHL with 200mm all aluminium alloy conductor (AAAC) poplar, which has a summer/winter (multi circuit) thermal rating of 26.6/33.2MVA. These works would give a capacity uplift of 5.4MVA, allowing forecast demand growth and LCT uptake with minimal intervention and capital expenditure.

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, the total of 2.8MW of capacity has been accepted between 2023-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.3. Accepted flexible capacity at Larbert primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.4	0.9	1.5	-	-

Troon Primary

Troon primary is fed from Kilmarnock Town GSP via two 33kV circuits comprising a combination of OHL and UGC. The firm capacity of the group is set by the lowest rated section of these two circuits. The circuit between Kilmarnock Town GSP 3A1 and Troon Primary T1 contains a mix of 0.3in Al UGC and 185mm Al UGC, which have winter cyclic thermal ratings of 16.3MVA and 17.4MVA, respectively. The proposed solution is to overlay the UGC with 400mm Al XLPE UGC, which has a winter, cyclic, thermal rating of 31.1MVA. The proposed works would give a capacity uplift of 4.18MVA, allowing forecast demand growth and LCT uptake with minimal intervention and capital expenditure.

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, the total of 1.5MW of capacity has been accepted between 2024-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.4. Accepted flexible capacity at Troon primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	-	0.5	1.0	-	-

St Ninians Cornhill Primary

St Ninians Cornhill primary is fed from Stirling GSP via two 33kV circuits comprising a mainly UGC with short sections of OHL. The firm capacity of the group is set by the lowest rated section of these two circuits. The circuit between Stirling GSP 3A3 and St Ninians Cornhill Primary T2 has a short section of 0.3in Al UGC. This small section of circuit limits the firm capacity of the group to 17.4MVA, based on a winter, cyclic, thermal rating. The next lowest rated section of circuit has a thermal rating of 21.6MVA. The proposed solution is to overlay the 0.3ins Al UGC with 400mm Al XLPE UGC,

which has a winter, cyclic, thermal rating of 31.1MVA. The proposed works would provide a capacity uplift of 4.18MVA, allowing forecast demand growth and LCT uptake with minimal intervention and capital expenditure.

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, the total of 2.3MW of capacity has been accepted between 2024-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.5. Accepted flexible capacity at St Ninians primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	-	0.7	1.6	-	-

Table 5.6 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.6. Proposed option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV OHL (Pole Line) Conductor	2.6	0.068	0.068	-
33kV Pole	26	0.078	0.078	-
33kV UG Cable (Non Pressurised)	0.74	0.148	0.148	-
Pilot Wire Overhead	2.6	0.070	0.070	-
Pilot Wire Underground	0.74	0.082	0.082	-
Wayleaves/Easements/Land Purchase		0.015	0.015	-
Other Costs (Identify Below)		0.077	0.077	-
Flexibility Services		0.012	0.012	-
Total Costs		0.549	0.549	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Environmental considerations (£17k)				
Planning and design (£60k)				

The baseline view forecasts an operationally manageable level of demand during the first four years of RIIO-ED2. For that reason, it is proposed to do the works in 2027/28, with a capacity of 10MVA released in the same year upon completion of the proposed works.

5.2 Option 1 – Overlay/re-string full 33kV feeder circuits

Option 1 proposes to Overlay/re-string the full 33kV feeder circuits to Commercial Rd, Troon, St Ninians and Larbert Primaries. At each site, the circuit will be overlaid with UGC or re-strung with OHL of a higher thermal rating than the demand forecast until the end of RIIO-ED3. The works will increase the firm capacity of the following primary substations:

- Commercial Rd primary
- Larbert primary
- Troon primary
- St Ninians Cornhill primary

Table 5.7. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	33kV Circuit Upgrades	Overlay/re-string full 33kV feeder circuits to Commercial Rd, Troon, St Ninnians and Larbert Primaries.	8.434	-

Commercial Rd Primary

Commercial Rd primary is fed from Hawick GSP via two 33kV circuits comprising a combination of OHL and UGC. The firm capacity of the group is set by the lowest rated section of these two circuits. The circuit between Hawick GSP 3A1 and Commercial Road primary T1 has a small section (0.13km) of 0.1ins copper (Cu) underground cable. This small section of circuit limits the firm capacity of the group to 13.5MVA, based on a winter, cyclic, thermal rating. The next lowest rated section of circuit has a thermal rating of 21.8MVA. The proposed solution is to overlay the 0.1ins Cu UGC with 240mm Aluminium (Al) cross-linked polyethylene (XLPE) UGC, which has a winter, cyclic, thermal rating of 26.7MVA. The proposed works would provide a capacity uplift of 8.3MVA, allowing forecast demand growth and Low Carbon Technologies (LCT) uptake with minimal intervention and capital expenditure. This is an enduring solution, providing thermal headroom beyond RIIO-ED3.

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, the total of 2MW of capacity has been accepted between 2023-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.8. Accepted flexible capacity at Commercial Rd primary 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	0.7	1.0	-	-

Larbert Primary

Larbert primary is fed from Bonnybridge GSP via two 33kV circuits comprising a combination of OHL and UGC. The proposed program of work is to overlay the full UGC route with 400mm Al XLPE UGC, which has a winter, cyclic, thermal rating of 31.1MVA and re-string the full OHL route with 200mm all aluminium alloy conductor (AAAC) poplar, which has a summer/winter (multi circuit) thermal rating of 26.6/33.2MVA. These works would give a capacity uplift of 14.8MVA, facilitating forecast demand growth and LCT uptake beyond RIIO-ED3.

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, the total of 2.8MW of capacity has been accepted between 2023-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.9. Accepted flexible capacity at Larbert primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.4	0.9	1.5	-	-

Troon Primary

Troon primary is fed from Kilmarnock Town GSP via two 33kV circuits comprising a combination of OHL and UGC. The proposed program of work is to overlay the full UGC route with 400mm Al XLPE UGC, which has a winter, cyclic, thermal rating of 31.1MVA and re-string the full OHL route with 200mm all aluminium alloy conductor (AAAC) poplar, which has a summer/winter (multi circuit) thermal rating of 26.6/33.2MVA. These works would give a capacity uplift of 9.49MVA, facilitating forecast demand growth and LCT uptake until the end of RIIO-ED3.

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, the total of 1.5MW of capacity has been accepted between 2024-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.10. Accepted flexible capacity at Troon primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	-	0.5	1.0	-	-

St Ninians Cornhill Primary

St Ninians Cornhill primary is fed from Stirling GSP via two 33kV circuits comprising a mainly UGC with short sections of OHL. The proposed program of work is to overlay the full UGC route with 400mm Al XLPE UGC, which has a winter, cyclic, thermal rating of 31.1MVA and re-string the OHL with 200mm all aluminium alloy conductor (AAAC) poplar, which has a summer/winter (multi circuit) thermal rating of 26.6/33.2MVA. These works would give a capacity uplift of 9.49MVA, facilitating forecast demand growth and LCT uptake until the end of RIIO-ED3.

The tender returns to date have not identified enough capacity to manage the constraint. This proposal therefore progresses conventional options to ensure the network remains safe and secure. Flexibility tenders will be run annually to continue to give the market the opportunity to meet the required level of flexibility at this location.

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, the total of 2.3MW of capacity has been accepted between 2024-2026, which is shown in Table 5.4. The cost of flexibility services has been added to the proposed solution.

Table 5.11. Accepted flexible capacity at St Ninians primary from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	-	0.7	1.6	-	-

Table 5.6 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.12. Option 1 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV OHL (Pole Line) Conductor	25.9	0.677	0.677	-
33kV Pole	259	0.776	0.776	-
33kV UG Cable (Non Pressurised)	18.5	3.693	3.693	-
Pilot Wire Overhead	25.9	0.700	0.700	-
Pilot Wire Underground	18.5	2.049	2.049	-
Wayleaves/Easements/Land Purchase		0.200	0.200	-
Other Costs (Identify Below)		0.327	0.327	-
Flexibility Services		0.012	0.012	-
Total Costs		8.434	8.434	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Environmental considerations (£222k)				
Planning and design (£105k)				

5.3 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.13.

Table 5.13. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Overlay/re-string lower rated sections of circuit	0.549
Option 1	Overlay/re-string full 33kV feeder circuits to Commercial Rd, Troon, St Ninians and Larbert Primaries.	8.434

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 the baseline option to overlay and re-string sections of circuit at Commercial Rd, Larbert, Troon and St Ninians Cornhill primary substations.

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 against other options. The summary of the cost benefit analysis is presented in Table 6.1. The full detailed CBA is provided within 'ED2-LRE-SPD-023-CV1-CBA – 33kV Circuit Upgrades'.

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 - Overlay/re-string lower rated sections of circuit	**Adopted**					
Option 1- Overlay/re-string full 33kV circuits	Rejected	Discounted on NPV	-0.82	-0.63	-0.51	-0.39

6.3 Cost & Volumes Profile

Table 6.2 shows the breakdown of expenditure for the proposed scheme (in 2020/21 prices). 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 £0.537m and further £0.012m to procure flexibility services in the group.

Table 6.2: Summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV OHL (Pole Line) Conductor	2.6	0.068	0.068	-
33kV Pole	26	0.078	0.078	-
33kV UG Cable (Non Pressurised)	0.74	0.148	0.148	-
Pilot Wire Overhead	2.6	0.070	0.070	-
Pilot Wire Underground	0.74	0.082	0.082	-
Wayleaves/Easements/Land Purchase		0.015	0.015	-
Other Costs (Identify Below)		0.077	0.077	-
Flexibility Services		0.012	0.012	-
Total Costs		0.549	0.549	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Environmental considerations (£17k)				
Planning and design (£60k)				

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)	**0.537**	-	-	-	-	0.537
CV1 (Flexible Service)	**0.012**	0.000	0.001	0.010	-	
Total Cost	**0.549**	**0.000**	**0.001**	**0.010**	**-**	**0.537**

6.4 Risks

The main delivery risks for the proposed works are, the cable route, and, security of supply during construction outages. Outages will result in load centres associated with Commercial Road, Larbert, Troon and St Ninians primary substations being on single circuit risk.

We would mitigate risks associated with the cable route by engaging with local authorities. To minimise risk associated with construction outages, it is proposed that the transformer replacement be undertaken on an off-line basis. The risk will also be minimised by having suitable contingency plans

for the reconnection of lost supplies in the event of loss of remaining infeed's during construction outages.

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 drivers for this investment are insufficient thermal headroom and EREC P2/7 compliance. 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 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, Table 6.5, Table 6.6 and Table 6.7 show electric vehicle and heat pump uptakes across a range of future pathways for each of the four demand groups.

Table 6.4: Electric Vehicle and Heat Pump uptakes across a range of future pathways at Commercial Rd primary

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	1,185		1,331	1,561	1,422	979	1,547	1,409	1,409
HPs	1,014		1,072	1,749	874	720	994	904	855

*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: Electric Vehicle and Heat Pump uptakes across a range of future pathways at Larbert primary

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	2,878		3,087	3,669	3,452	2,377	3,756	3,421	3,421
HPs	992		1,066	1,942	777	873	833	629	824

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

Table 6.6: Electric Vehicle and Heat Pump uptakes across a range of future pathways at Troon primary

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	2,957		3,426	3,967	3,547	2,442	3,859	3,515	3,515
HPs	992		1,079	1,997	759	97	801	568	822

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

Table 6.7: Electric Vehicle and Heat Pump uptakes across a range of future pathways at St Ninians Cornhill primary

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	3,163		3,378	4,080	3,794	2,613	4,128	3,760	3,760
HPs	2,012		2,251	3,092	1,716	1,472	1,938	1,728	1,694

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

Table 6.8, Table 6.9, Table 6.10 and Table 6.11 show the sensitivity of the proposed solution and Table 6.12 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 6.8: Sensitivity of the proposed solution against future pathways at Commercial Rd primary

Solution Requirements	RIIO-ED1				RIIO-ED2					RIIO-ED3				
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Baseline					F	F	F	F	R1					
Consumer Transformation							F	F	R1					
Leading the Way								F	R1					
Balanced Net Zero Pathway								F	R1					
Headwinds									R1					
Widespread Engagement							F	F	R1					
Widespread Innovation							F	F	R1					
Tailwinds							F	F	R1					

R1 – Overlay 0.2km of UGC

Table 6.9: Sensitivity of the proposed solution against future pathways at Larbert primary

Solution Requirements	RIIO-ED1				RIIO-ED2					RIIO-ED3				
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Baseline					F	F	F	F	R1				R2	
Consumer Transformation							F	R1				R2		
Leading the Way									R1		R2			
Balanced Net Zero Pathway								F	R1				R2	
Headwinds									R1					
Widespread Engagement							F	R1				R2		
Widespread Innovation								F	R1				R2	
Tailwinds								F	R1				R2	

R1 – Overlay 0.04km of UGC and restring 2.60km of OHL

F – Increased flexibility services (+£0.012m)
R2 – Further 5.9km of 33kV circuit upgrade

Table 6.10: Sensitivity of the proposed solution against future pathways at Troon primary

	RIIO-ED1				RIIO-ED2					RIIO-ED3				
Solution Requirements	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Baseline							F	F	R1				R2	
Consumer Transformation							F	R1				R2		
Leading the Way									R1		R2			
Balanced Net Zero Pathway							F	F	R1				R2	
Headwinds									R1					
Widespread Engagement							F	R1				R2		
Widespread Innovation							F	F	R1				R2	
Tailwinds							F	F	R1				R2	

R1 – Overlay 0.2km of UGC
F – Utilise flexibility services (+£0.005m)
R2 – Further 33km of 33kV circuit upgrade

Table 6.11: Sensitivity of the proposed solution against future pathways at St Ninians Cornhill primary

	RIIO-ED1				RIIO-ED2					RIIO-ED3				
Solution Requirements	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
Baseline									R1			R2		
Consumer Transformation							F	R1			R2			
Leading the Way									R1		R2			
Balanced Net Zero Pathway									R1		R2			
Headwinds									R1				R2	
Widespread Engagement							F	R1		R2				
Widespread Innovation								F	R1		R2			
Tailwinds								F	R1		R2			

R1 – Overlay 0.3km of UGC
F – Utilise flexibility services (+£0.016m)
R2 – Further 4.54km of 33kV circuit upgrade

The proposed solution is robust across all range of pathways. The timing of the requirement is slightly sensitive to uptake rates but is found to be required under all scenarios within the RIIO-ED2 period. In addition, increased flexibility services might be required under higher uptake scenarios within RIIO-ED2 and a further 33kV circuits upgrades might be required in RIIO-ED3 under all scenarios with different timings at Larbert, Troon and St Ninians Cornhill demand groups.

Table 6.12: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	**Uncertain**
RIIO-ED2 Expenditure (£m)	0.549	+0.033
Comment	Proposed option	Increased flexibility services in RIIO-ED2. Further 33kV circuit upgrades in RIIO-ED3.

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 been considered as part of this design solution and it has not been necessary to carry out any losses justified upgrades. MWh losses for each of the options have been included within the cost benefit analysis and solution selection was not found to be sensitive to the impact of the carbon cost of losses.

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 43.5 tonnes. The monetised embodied carbon value associated with this emission is £3.1k. 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[1].

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 delivery of our 33kV Circuit Upgrades will result in embodied carbon emissions from the manufacture and supply of components and materials associated with the programme, but there is likely to be little or no impact on our Business Carbon Footprint.

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

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts associated of our 33kV Circuit Upgrades, 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

Our 33kV Circuit Upgrades 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).

6.7.4 Biodiversity / Natural Capital

The 33kV Circuit Upgrades involves upgrades to underground cables and overhead lines, with the potential to affect local biodiversity. Any impacts on habitats and biodiversity are expected to be localised and temporary in nature and we will seek to avoid or minimise disturbance to soils and vegetation as far as possible. In cases where vegetation clearance or soil disturbance cannot be avoided, we will implement measures to restore and enhance habitats, working with relevant local stakeholders (e.g., landowners, wildlife and woodland trusts) where possible to identify opportunities to deliver biodiversity and environmental net gain.

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, and 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. Given the nature of our underground cables, climate resilience is of less concern within this programme of works relative to other programmes within RIIO-ED2.

7 Conclusion

This engineering justification paper proposes to overlay sections of underground cable and re-string sections of over headline that are forecast to be thermally overloaded within the RIIO-ED2 period. The proposed works will increase the firm capacity of the following four primary substations:

- Commercial Rd primary
- Larbert primary
- Troon primary
- St Ninians Cornhill primary

Flexibility services were sought as a solution to delay reinforcement. 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 and reduce risk during delivery, flexibility services have been accepted at the constrained demand groups (1.5MW at Troon primary, 2.8MW at Larbert primary, 2.3MW at St Ninians primary and 2MW at Commercial Road primary).

The estimated cost for the above is £0.549m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

It is recommended to continue annual tendering for flexibility in this area to procure enough capacity. The proposed solution will be reviewed depending on procuring enough capacity in the future tenders.

The baseline view forecasts an operationally manageable level of demand during the first four years of RIIO-ED2. For that reason, it is proposed to do the works in 2027/28, with a capacity of 22.06MVA released in the same year upon completion of the proposed works.

8 Appendices

Appendix 1. System Study Results

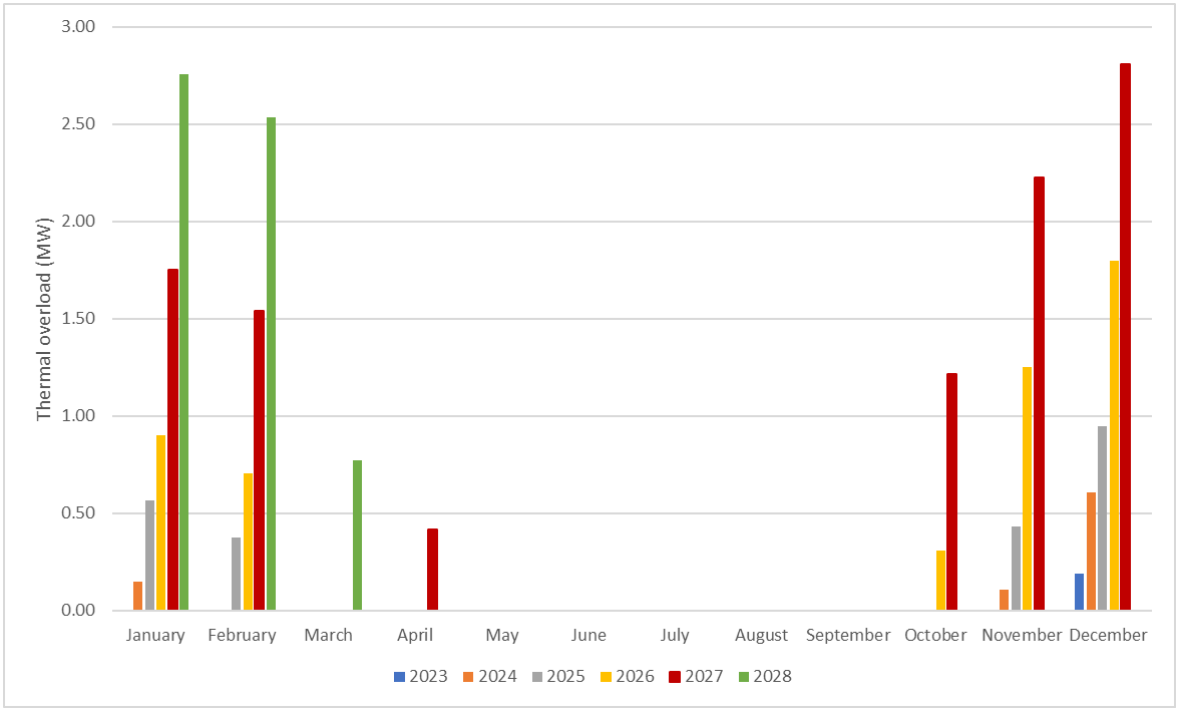

Figure 13. Monthly maximum overload on 33kV circuit feeding Commercial Rd primary

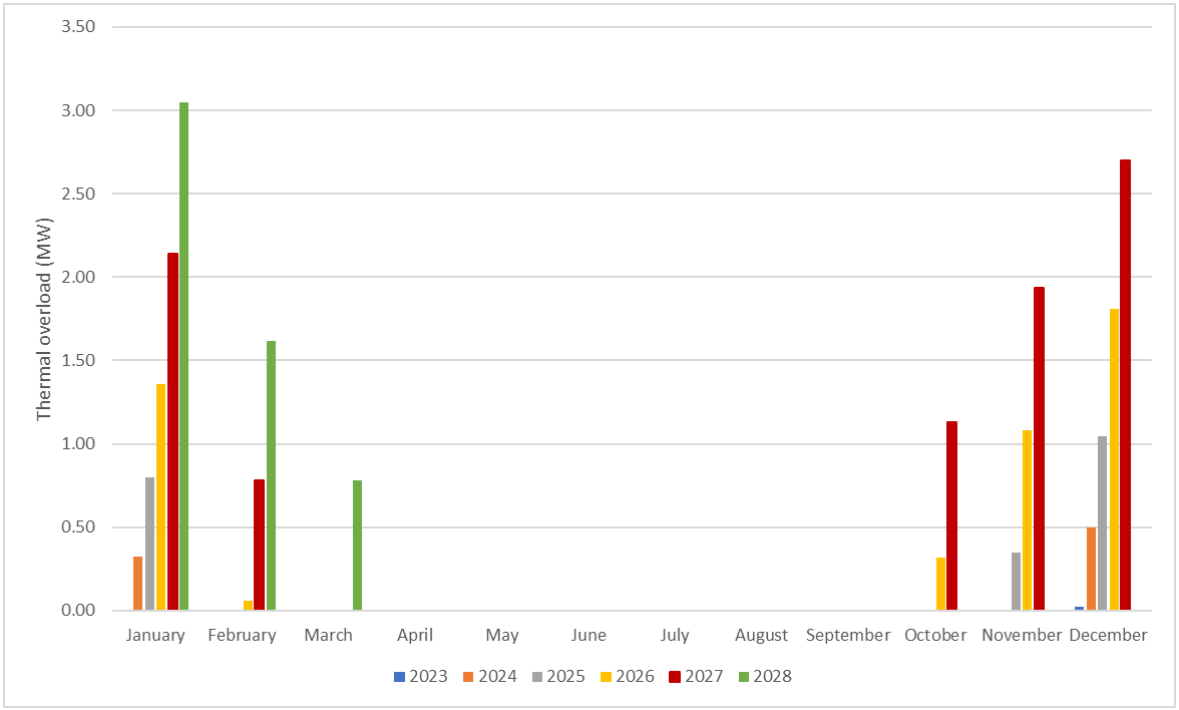

Figure 14. Monthly maximum overload on 33kV circuit feeding Larbert primary

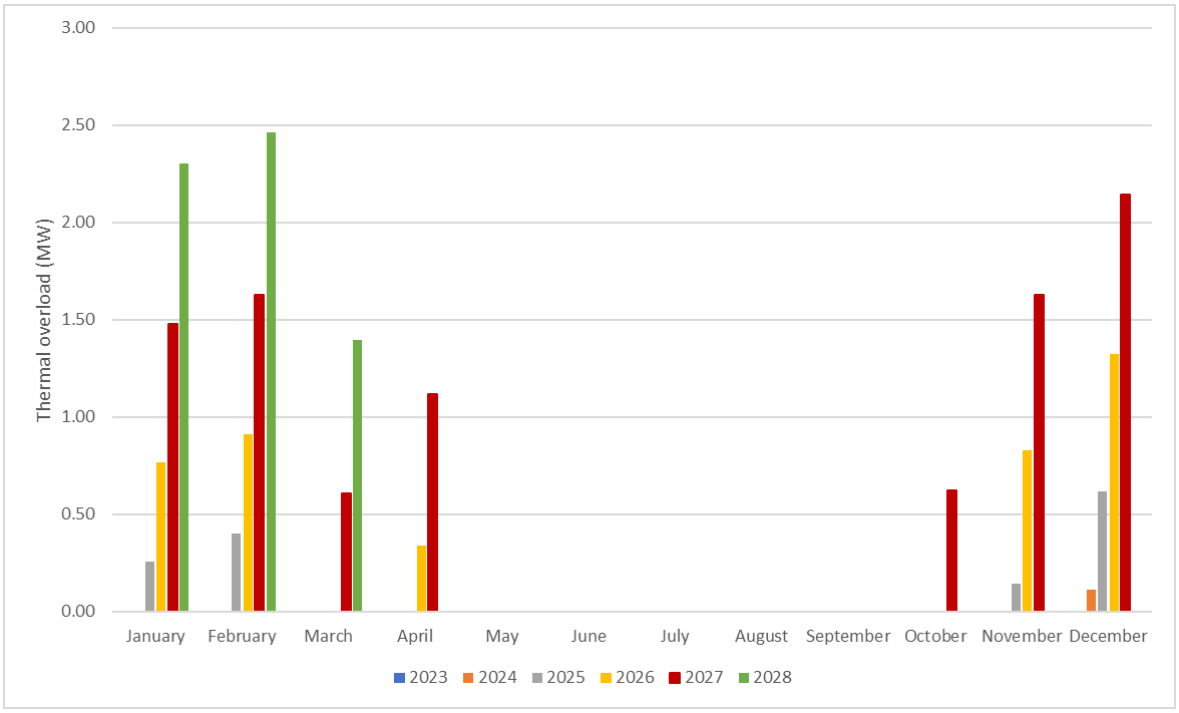

Figure 15. Monthly maximum overload on 33kV circuit feeding Troon primary

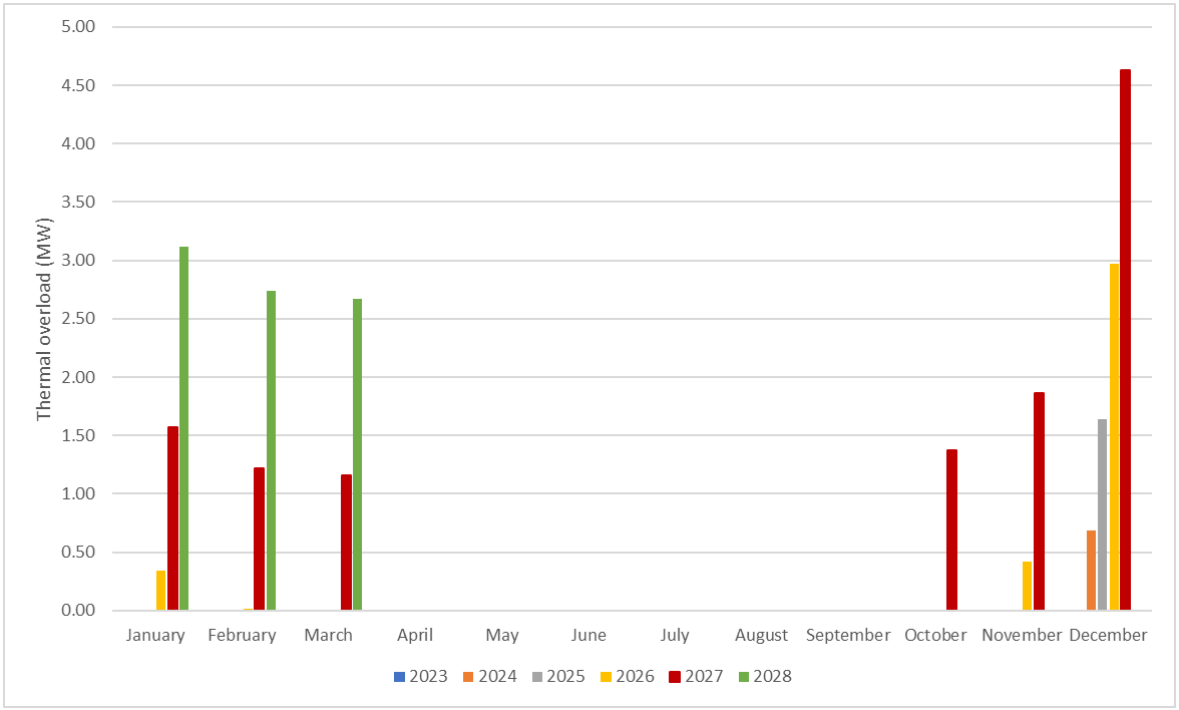

Figure 16. Monthly maximum overload on 33kV circuit feeding St Ninians Cornhill primary