Hamilton Primary Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-002-CV1-EJP

Issue	Date	Comments
Issue 0.1	Jan 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	Hamilton Primary Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-002-CV1		
Output	Load Index		
Cost	£1.151m		
Delivery Year	2024		
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	**£1.151m**	**£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:	**Hamilton Primary Reinforcement**
Project Reference:	**ED2-LRE-SPD-002-CV1**
Decision Required:	**To give concept approval for the use of flexibility services in combination with network automation to manage a 33kV transformer and circuit constraint in the Hamilton demand group.**

Summary of Business Need:

The Hamilton 33/11 kV primary group supplies 5,905 customers in the South Lanarkshire region of the SP Distribution (SPD) licence area. With the forecast uptake of LCT, the group demand at Hamilton primary is forecast to exceed its firm capacity by the end of RIIO-ED2 period with risk of thermal loading on Hamilton 33/11kV transformers and the 33kV circuits supplying the site. Half-hourly time-profile studies have been undertaken to quantify the hours at risk and to define the flexibility services that would be required to manage the constraint.

The proposed solution uses a combination of automation to transfer load to adjacent primaries, and flexibility to reduce the reliance on this transfer.

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

To accommodate the future demand, the proposed scheme upgrades HV feeders and uses HV automation to transfer up to 2MW of demand to adjacent primaries under N-1 conditions. Flexibility will be used to reduce the level of load transfer. This defers ca. £5.475m associated with the replacement of the primary transformers and installation of higher rated circuits.

The estimated cost for the above is £1.151m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

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	**1.040**	1.040				
SPD	CV1	Flexible Services	**0.112**	0.001	0.006	0.015	0.034	0.057
	Total		**1.151**	**1.041**	**0.006**	**0.015**	**0.034**	**0.057**

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

Hamilton 33/11 kV primary group is geographically located in the South Lanarkshire region of SP Distribution (SPD) licence area. The group supplies to Hamilton town and currently serves ca. 5,905 customers.

Historically, the group demand at Hamilton primary is approaching the 21MVA firm capacity of the group. Our baseline View projects demand growth up to 22.2MVA peak, with an expected uptake of up to 968 electric vehicles and 419 heat pumps by the end of the RIIO-ED2 period.

To accommodate the future demand, the proposed scheme upgrades an HV feeder and uses HV automation to transfer up to 2MW of demand to adjacent primaries under N-1 conditions. Flexibility will be used to reduce the reliance on this automation. This defers £5.475m of replacement of the 21MVA transformers, and associated installation of higher rated circuits into RIIO-ED3.

The estimated cost for the above is £1.151m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

Our Baseline View forecasts thermal overloading of the Hamilton primary transformers from 2025. For this reason, it is proposed to complete the works and claim the capacity release of 2MVA in 2023/24. Our timing of the project is based on ensuring security of supply of Hamilton primary demand group. In order to reduce the risk to supply, it is proposed to contract flexibility services during the project delivery, continuing until the deferred RIIO-ED3 reinforcement works are complete.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Hamilton primary 11kV demand group. The existing 11kV network is located in Hamilton town centre, which is in a built urban environment, comprising mainly underground cable (UGC). Hamilton primary is interconnected at 11kV with Burnbank, Leven Street and Neilsland substations as shown below in Figure 1. Existing 11kV Network

.

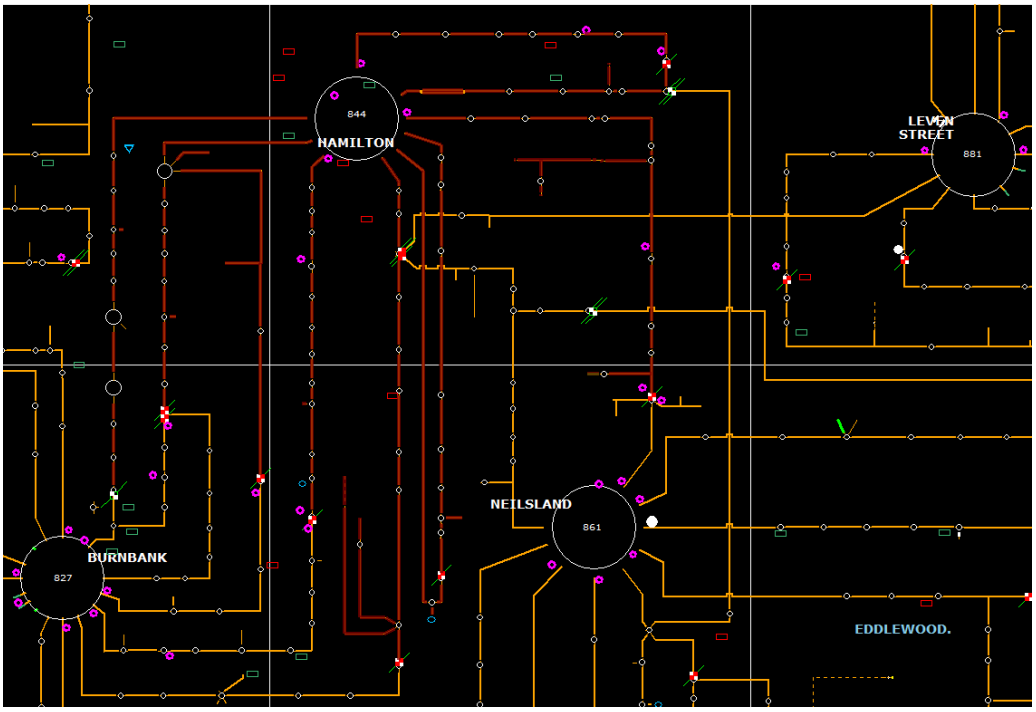

Figure 1. Existing 11kV Network

Hamilton primary substation is served by two 21MVA, Watford, 33/11kV transformers (1958). The HV group is fed from Strathaven GSP via the 33kV network shown in Figure 2. Hamilton T1 is interconnected, at 33kV, with Wishaw GSP via Leven Street switching station.

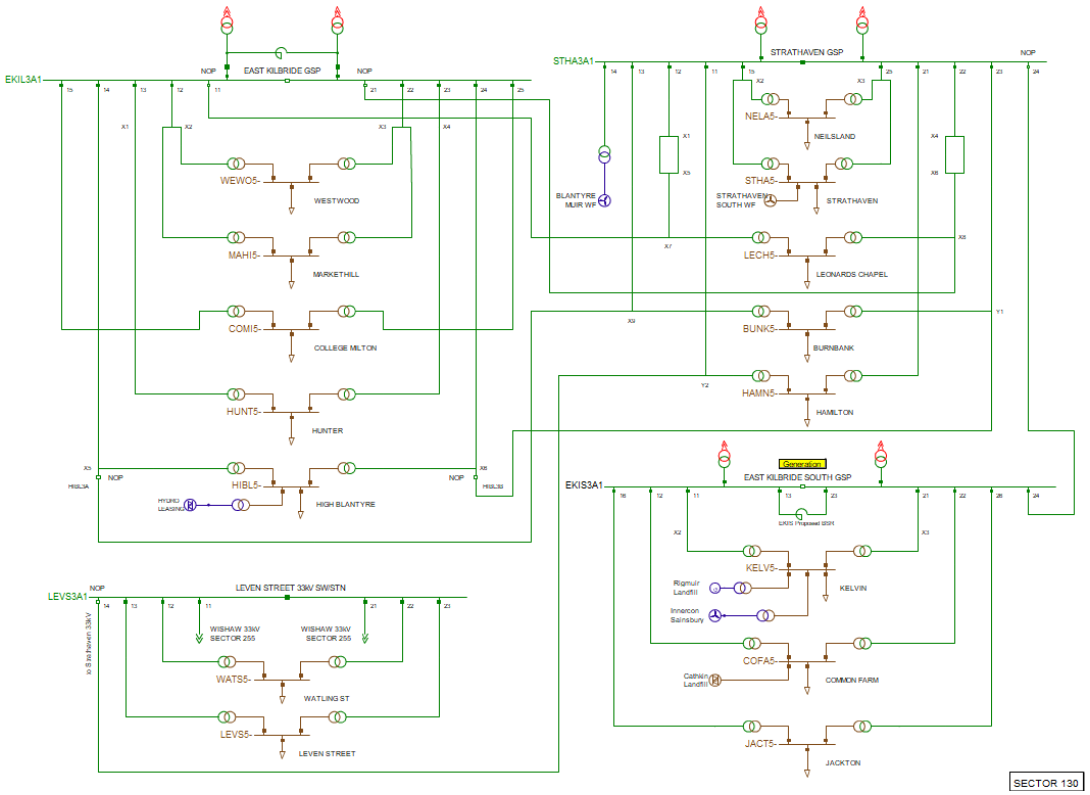

Figure 2. Existing 33kV Network

2.2 Group Demand & Security of Supply

The maximum load recorded on the Hamilton 33/11kV transformers was 19.5 MVA which a class 'C' of supply (over 12MW and up to 60MW) as per Energy Network Association (ENA) Engendering Recommendation (EREC) P2/7. Hamilton primary is fed via two 33kV UGC circuits. The minimum rated section of the circuit has a summer/winter cyclic (ducted) thermal rating of 20.8/21.6MVA. Hamilton primary substation is served by two 21MVA 33/11kV transformers.

2.3 Embedded Generation

Hamilton primary currently has less than 1MW of connected generation.

2.4 Fault Levels

Studies indicate that there are no fault level issues at Hamilton primary.

3 Needs Case

Our Baseline View forecasts a peak demand by 2028 of 22.2MVA, with an expected uptake of up to 968 electric vehicles and 419 heat pumps. This exceeds the Hamilton primary firm capacity of 21MVA 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 forecast based on the SPD Distribution Future Energy Scenarios, including authorised connections are depicted in Figure 3. The anticipated total electric vehicle and heat pump uptakes based on the future energy scenarios is depicted in Figure 4.

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.

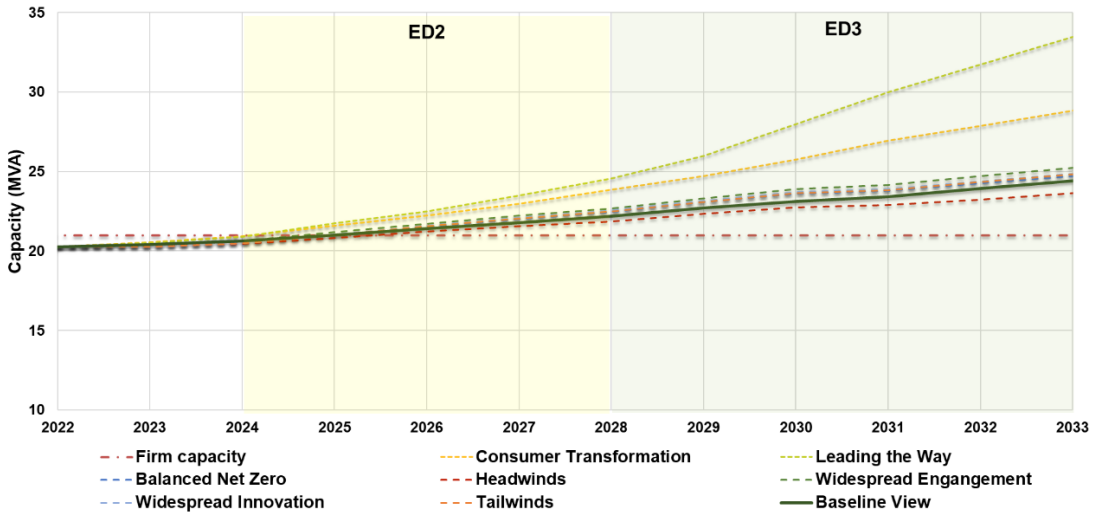

Figure 3. Demand (MVA) forecast for Hamilton demand group

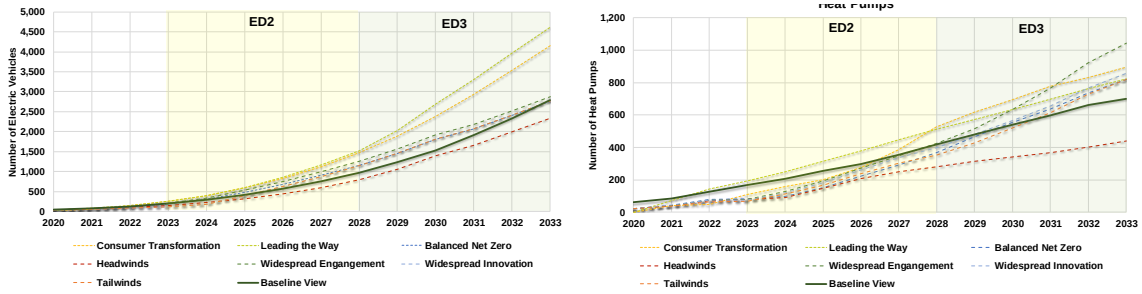

Figure 4. Forecast Electric Vehicle and Heat Pump uptakes for Hamilton demand group

3.1.2 Baseline View

For the Hamilton 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)	20.3	20.4	20.6	21.0	21.4	21.8	22.2	22.2	23.1	23.4	23.9	24.4
Firm Capacity (MVA)	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0
Utilisation (%)	96	97	98	100	102	104	106	108	110	112	114	116
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 Hamilton demand group 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 3.2 shows the identified thermal constraints on the 33/11kV network level.

Table 3.2. Thermal constraints at 33/11kV level

Network Item	Voltage	Outage
Hamilton T1	33/11 kV	N-1
Hamilton T2	33/11 kV	N-1
Circuit Strathaven GSP – Hamilton T1	33 kV	N-1
Circuit Strathaven GSP – Hamilton T2	33 kV	N-1

3.2.2 Voltage Constraints

There are no voltage constraints associated with Hamilton primary demand group.

3.2.3 EREC P2/7 – Security of Supply

Hamilton primary substation has a forecast peak demand of 21.1MW (22.2MVA) by the end of RIIO-ED2. Engineering Recommendation (EREC) P2/7 defines a group demand of 21.1MW 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):

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

Hamilton group demand has an FCO security of 21MVA. Therefore, this site is 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 on the 33/11kV Hamilton primary transformers 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 in 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)	8	25	44	77	107
Required Flexible Capacity (MW)	0.60	1.15	1.70	2.20	2.66

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.

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)	Utilise flexibility services and install HV automated load transfer scheme	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	Replace 21MVA transformers with 32MVA units and install new 33kV circuits between Strathaven GSP and Hamilton primary	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Establish a new primary substation	Shortlisted as **Option 2** in Detailed Analysis	
(f)	Utilization of Flexibility Services to defer reinforcement into RIIO-ED3.	Rejected	Flexibility services were sought but Insufficient flexible capacity was available for flexibility to resolve the issues on its own.
(f)	Application of real-time thermal monitoring on the Hamilton primary transformers (innovation)	Rejected	Insufficient capacity released. This solution would be unable to manage thermal constraints on the circuits supplying Hamilton primary substation from Strathaven GSP.

5 Detailed Analysis & Costs

5.1 Proposed Option (Baseline) – Flexibility Services and HV Automated Load Transfer Scheme

The proposed option for this scheme is to defer the reinforcement with the combination of utilising flexibility services and HV automated load transfer scheme. 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	Hamilton Primary Reinforcement	HV automated load transfer scheme Utilise flexibility services to manage network constraints	1.151	-

Network studies indicate that the thermal loading of the Hamilton primary transformers and the 33kV Strathaven GSP – Hamilton UGC circuit can be managed through RIIO-ED2 to the end of RIIO-ED3 by transferring up to ca. 2MVA into adjacent primaries. To enable this load transfer, an additional HV feeder is required from Leven Street primary to the HV feeder network supplied by Hamilton. An indicative cable route for the additional HV feeder is shown in Figure 5.

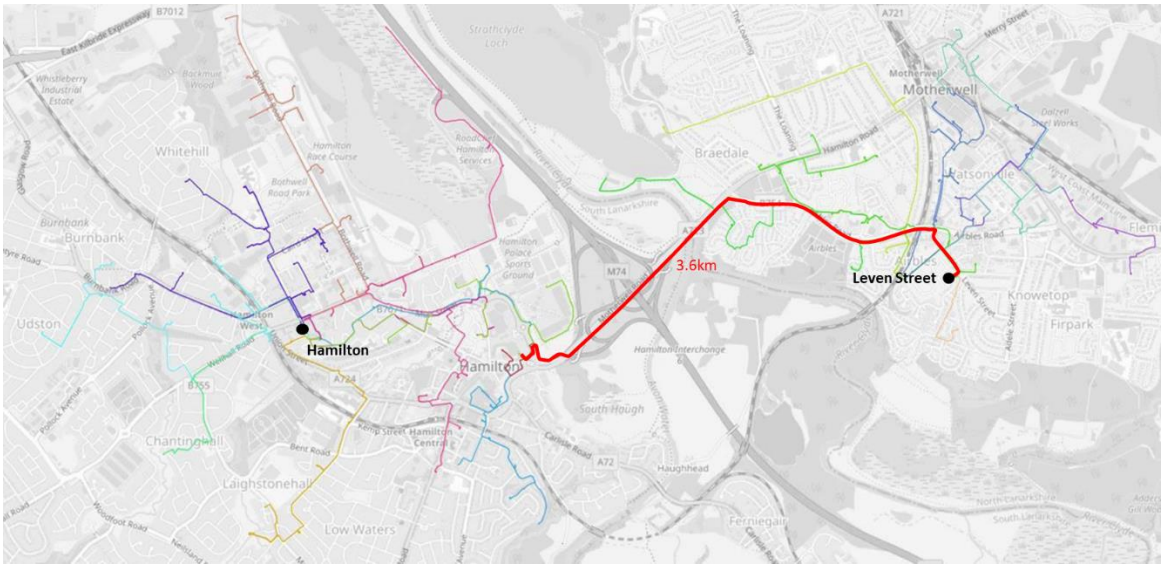

Figure 5. Indicative cable route for the additional HV feeder

Additionally, in order to facilitate market growth and manage network risk, a total of 8.3MW of capacity has been accepted between 2023-2028, which is shown in . The cost of flexibility services has been added to the proposed solution.

This option defers £5.475m of the replacement of the 21MVA transformers and associated installation of higher rated circuits into RIIO-ED3. The future reinforcement has been included in the CBA in addition to the £1.151m in the summary above.

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)	0.6	1.1	1.7	2.2	2.7

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	3.6	0.423	0.423	-
6.6/11kV CB (GM) Primary	1	0.028	0.028	-
6.6/11kV CB (GM) Secondary	4	0.049	0.049	-
Pilot Wire Underground	3.6	0.399	0.399	-
Other Costs (Identify Below)		0.141	0.141	-
Flexibility Services		0.112	0.112	-
Total Costs		1.151	1.151	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
HV Network Control Points (£41k)				
Directional drilling (£100k)				

Our Baseline View forecasts thermal overloading of the Hamilton primary transformers from 2025. For this reason, it is proposed to complete the works and claim the capacity release of 2MVA in 2023/24. Our timing of the project is based on ensuring security of supply of Hamilton primary demand group. In order to reduce the risk of supply, it is proposed to contract flexibility services during the project delivery, continuing until the deferred RIIO-ED3 reinforcement works are complete.

5.2 Option 1 – Replace Transformers and 33kV Circuits

This option would replace the existing 21MVA transformers with new 32MVA units and procure flexibility services to manage the network risk through the delivery stage at a cost of £7k. Table 5.4 shows the scheme summary. This option is not considered to offer value for money and has been discounted.

Table 5.4. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Hamilton Primary Reinforcement	Replace 21MVA transformers with 32MVA units and install new 33kV circuits between Strathaven GSP and Hamilton primary	5.481	-

An aerial view of the site is shown in Figure 6. Due to the proximity of residential properties, Low Noise MIDEL units would be required.

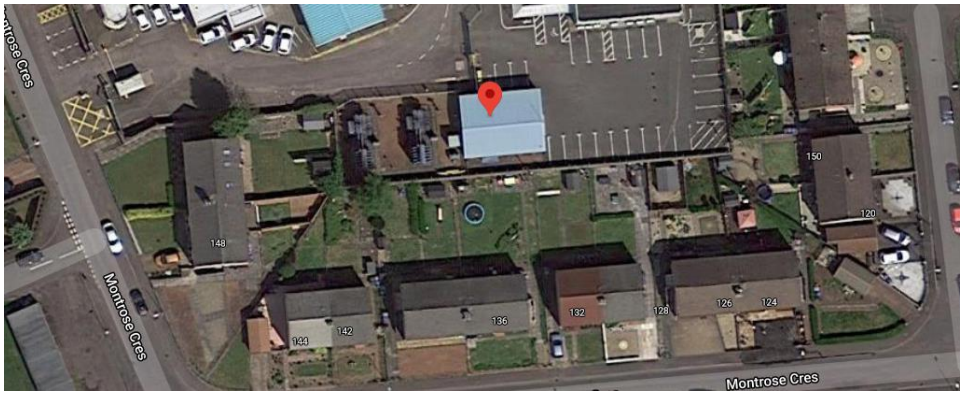

Figure 6. An aerial view of the site for Option 1

The 33kV circuits feeding the group have a cyclic summer/winter rating of 20.8/21.61MVA. Two new ca. 7km 33kV circuits of 400mm² Al UGC would be installed between Strathaven GSP and Hamilton primary. The combination of new circuits and transformers will release the full thermal capacity created by the transformers and thus facilitate the projected load growth.

A new firm capacity of 32MVA would provide 11MVA of additional thermal headroom for future load growth and the Hamilton Demand Group would be EREC P2/7 compliant. These works would replace the existing 1960s transformers with modern units.

The proposed 33kV network configuration is shown in Figure 7.

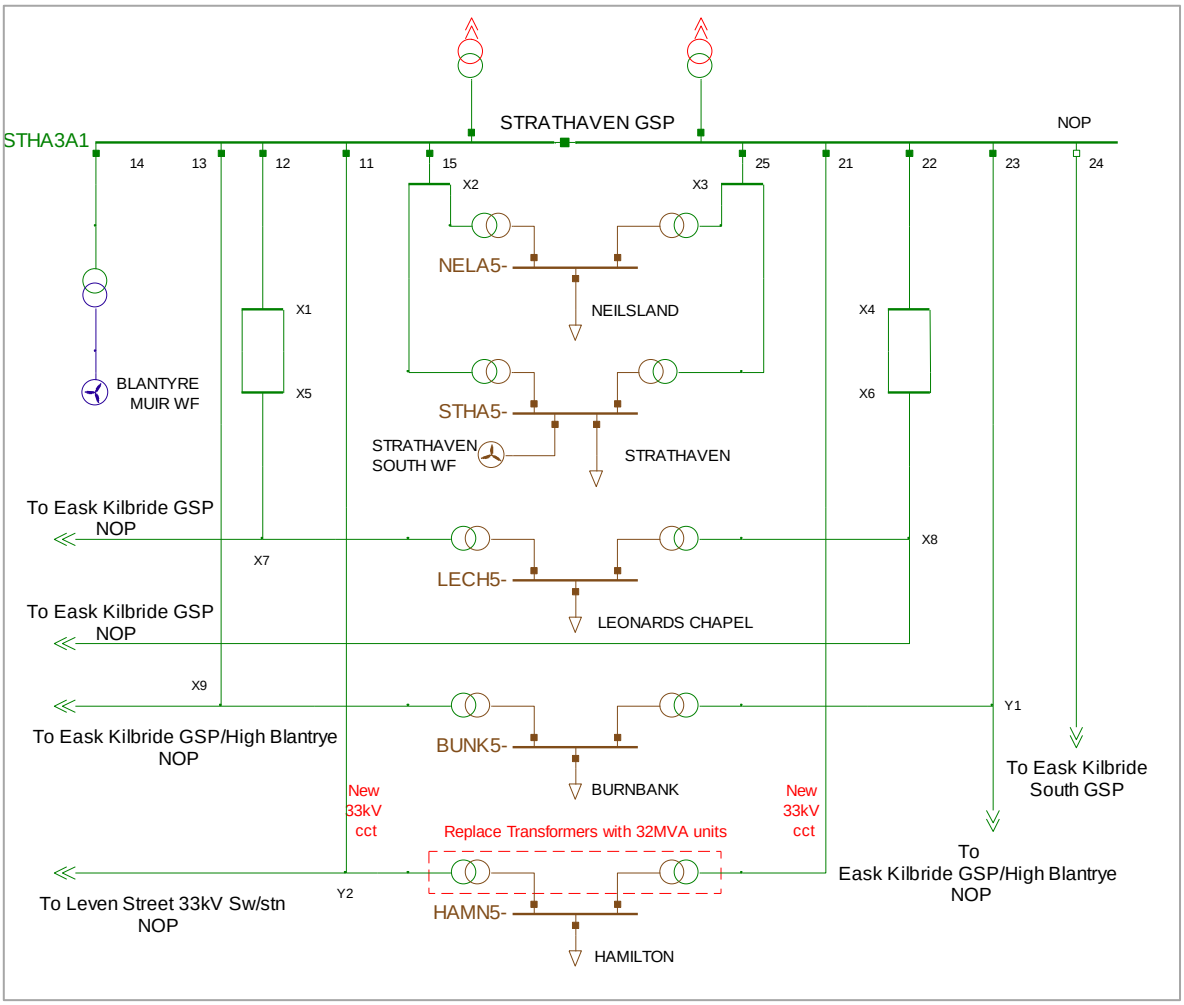

Figure 7. Schematic of the proposed 33kV network

Table 5.5 shows a summary of reinforcement costs and volumes for Option 1 under RIIO-ED2.

Table 5.5. Option 1 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	0.05	0.006	0.006	-
33kV UG Cable (Non Pressurised)	14	2.795	2.795	-
33kV Transformer (GM)	2	0.790	0.790	-
Pilot Wire Underground	14	1.551	1.551	-
Civil Works at 33 kV & 66 kV Substations		0.150	0.150	-
Wayleaves/Easements/Land Purchase		0.063	0.063	-
Other Costs (Identify Below)		0.120	0.120	
Flexibility Services		0.007	0.007	-
Total Costs		5.481	5.481	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£50k)				
Environmental consideration (£70k)				

5.3 Option 2 – Establish a New Primary Substation

This option considers the establishment of a new 33/11kV 10MVA primary substation in Hamilton with 11kV interconnection to Hamilton primary and procure flexibility services to manage the network risk through the delivery stage at a cost of £7k. The option would enable 10MVA additional network capacity. It will enable 5.5MVA of demand to be offloaded from Hamilton primary and so prevent thermal overloading.

Table 5.6 shows the scheme summary. This option is rejected based on cost.

Table 5.6. Option 2 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Hamilton Primary Reinforcement	Establish a new primary substation	5.561	-

The proposed 33kV network configuration is shown in Figure 8.

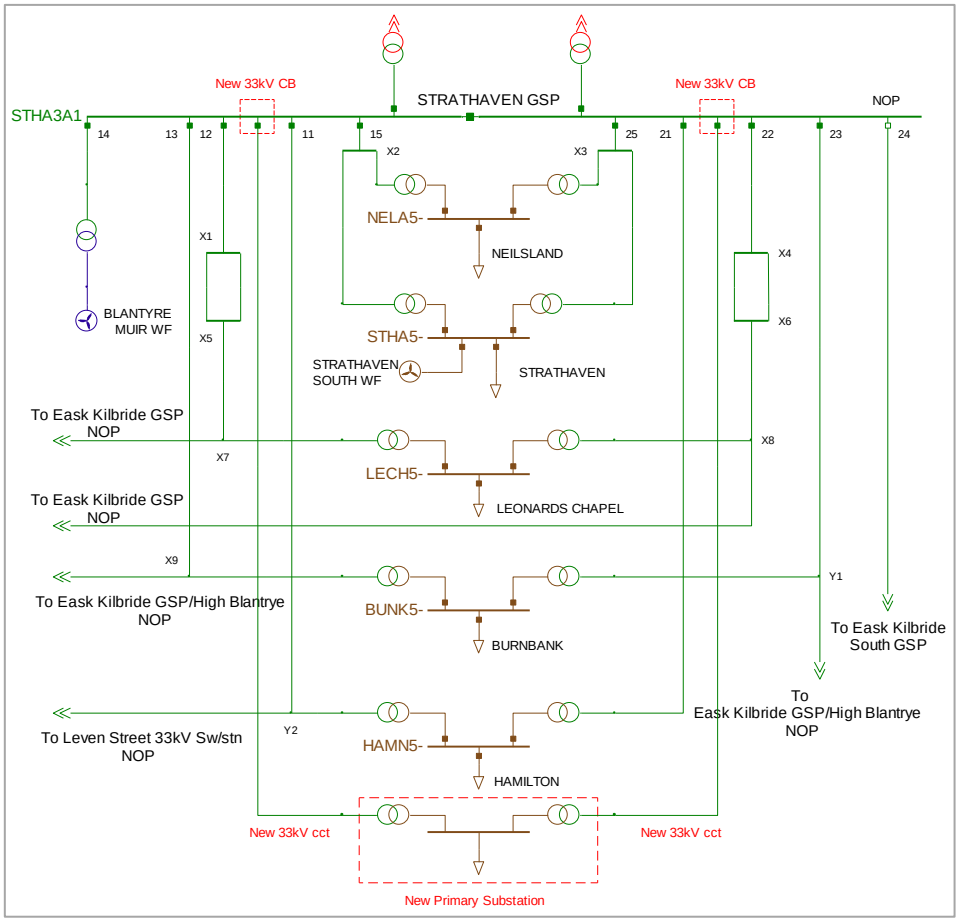

Figure 8. Schematic of the proposed 33kV network

Table 5.7 shows a summary of reinforcement costs and volumes for Option 2 under RIIO-ED2.

Table 5.7. Option 2 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV OHL (Conventional Conductor)	4	0.102	0.102	-
6.6/11kV UG Cable	0.05	0.006	0.006	-
6.6/11kV CB (GM) Primary	7	0.194	0.194	-
33kV UG Cable (Non Pressurised)	11	2.196	2.196	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	2	0.334	0.334	-
33kV Transformer (GM)	2	0.686	0.686	-
Batteries at 33kV Substations	2	0.018	0.018	-
Pilot Wire Underground	11	1.219	1.219	-
Civil Works at 33 kV & 66 kV Substations		0.500	0.500	-
Wayleaves/Easements/Land Purchase		0.150	0.150	-
Other Costs (Identify Below)		0.150	0.150	-
Flexibility		0.007	0.007	-
Total Costs		5.561	5.561	-
Identify Activities Included Within Other Costs				
Planning and design (£50k)				
Environmental consideration (£48k)				
RTU/SCADA (£42k)				
Remote end protection (£10k)				

5.4 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.8.

Table 5.8. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Flexibility services and HV automated load transfer scheme	1.151*
Option 1	Replace 21MVA transformers with 32MVA units and install new 33kV circuits between Strathaven GSP and Hamilton primary	5.481
Option 2	Establish a new primary substation in Hamilton	5.561

*Note: This option would defer the replacement of the 21MVA transformers and associated installation of higher rated circuits into RIIO-ED3 of £5.475 which has been included in CBA.

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 utilise of flexibility services and install HV automated load transfer scheme. This option defers £5.475m of replacement of the 21MVA transformers and associated installation of higher rated circuits into RIIO-ED3.

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-002-CV1-CBA – Hamilton 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 – Flexibility services and HV automated load transfer scheme	**Adopted**					
Option 1- Replace 21MVA transformers with 32MVA units and install new 33kV circuits between Strathaven GSP and Hamilton primary	Rejected	Discounted on NPV	-1.11	-0.62	-0.30	-0.04
Option 2 – Establish a new primary substation	Rejected	Discounted on NPV	-1.12	-0.64	-0.34	-0.08

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 £1.040m and further £0.112m to procure future 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)
6.6/11kV UG Cable	3.6	0.423	0.423	-
6.6/11kV CB (GM) Primary	1	0.028	0.028	-
6.6/11kV CB (GM) Secondary	4	0.049	0.049	-
Pilot Wire Underground	3.6	0.399	0.399	-
Other Costs (Identify Below)		0.141	0.141	-
Flexibility Services		0.112	0.112	-
Total Costs		1.151	1.151	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
HV Network Control Points (£41k)				
Directional drilling (£100k)				

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)	**1.040**	1.040		-	-	-
CV1(Flexible Services)	**0.112**	0.001	0.006	0.015	0.034	0.057
Total Cost	**1.151**	**1.041**	**0.006**	**0.015**	**0.034**	**0.057**

6.4 Risks

The main delivery risk is the cable route. We would mitigate the risk by engaging with local authorities.

There is a risk that the contracted flexibility services will not materialise. In order to overcome this risk, we will continue to tender for flexibility services for this location.

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 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	968		1,474	1,516	1,161	800	1,263	1,151	1,151
HPs	419		529	511	369	280	424	398	354

*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					R1	F	F	F	F	F	F	F	F	R2
Consumer Transformation					R1	F	F	F	F	F	F	F	R2	
Leading the Way						R1	F	F	F	F	F	R2		
Balanced Net Zero Pathway						R1	F	F	F	F	F	F	F	R2
Headwinds							R1	F	F	F	F	F	F	F
Widespread Engagement						R1	F	F	F	F	F	F	R2	
Widespread Innovation							R1	F	F	F	F	F	R2	
Tailwinds							R1	F	F	F	F	F	F	R2

F – Flexibility services
R1 – HV automation
R2 – Replace the 21MVA transformers and install associated higher rated circuits

The proposed solution is robust across a wide range of pathways. The selected solution is not sensitive to the uptake scenario – the proposed option is selected across all scenarios. The timing of the requirement is sensitive to uptake rates but is found to be required under all scenarios within the RIIO-ED2 period. In the higher uptake scenarios, the requirement for the HV automation is found at the start of RIIO-ED2. In some scenarios, with greater energy efficiency assumptions, the requirement is identified mid in RIIO-ED2. In seven of eight scenarios a subsequent intervention is required in late RIIO-ED3. The 21MVA transformers require replacement with associated installation of higher rated circuits. The timing of this subsequent requirement is sensitive to uptake rates and the level of flexibility available during the RIIO-ED3 period.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	**Uncertain**
RIIO-ED2 Expenditure (£m)	1.151	N/A
Comment	Proposed option	

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 28.9 tonnes. The monetised embodied carbon value associated with this emission is £1.25k. 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 Hamilton Primary Reinforcement programme has the potential to impact on the embodied carbon resulting from the delivery of the programme. However, there is likely to be little or no impact on SPEN's Business Carbon Footprint (BCF).

Upfront costs associated with this programme (e.g. embodied carbon from the manufacture and supply of components and associated civil engineering works) should be considered against our ongoing operational need to maintain the resilience of our assets and networks.

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts associated of the Hamilton Primary Reinforcement programme, 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.

We believe that such a requirement sends a strong message to our suppliers that we take sustainability seriously, and that such positive engagement is key to improving the overall sustainability of our collective supply chain.

6.7.3 Resource Use and Waste

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

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

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 Hamilton 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.

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

To accommodate the future demand, the proposed scheme upgrades an HV feeder and uses HV automation to transfer up to 2MW of demand to adjacent primaries under N-1 conditions. Flexibility will be used to reduce the reliance on this automation. This defers £5.475m of replacement of the 21MVA transformers, and associated installation of higher rated circuits into RIIO-ED3.

The estimated cost for the above is £1.151m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

Our Baseline view forecasts thermal overloading of the Hamilton primary transformers from 2025. For this reason, it is proposed to complete the works and claim the capacity release of 2MVA in 2023/24. Our timing of the project is based on ensuring security of supply of Hamilton primary demand group. In order to reduce the risk of supply, it is proposed to contract flexibility services during the project delivery, continuing until the deferred RIIO-ED3 reinforcement works are complete.

8 Appendices

Appendix 1. System Study Results

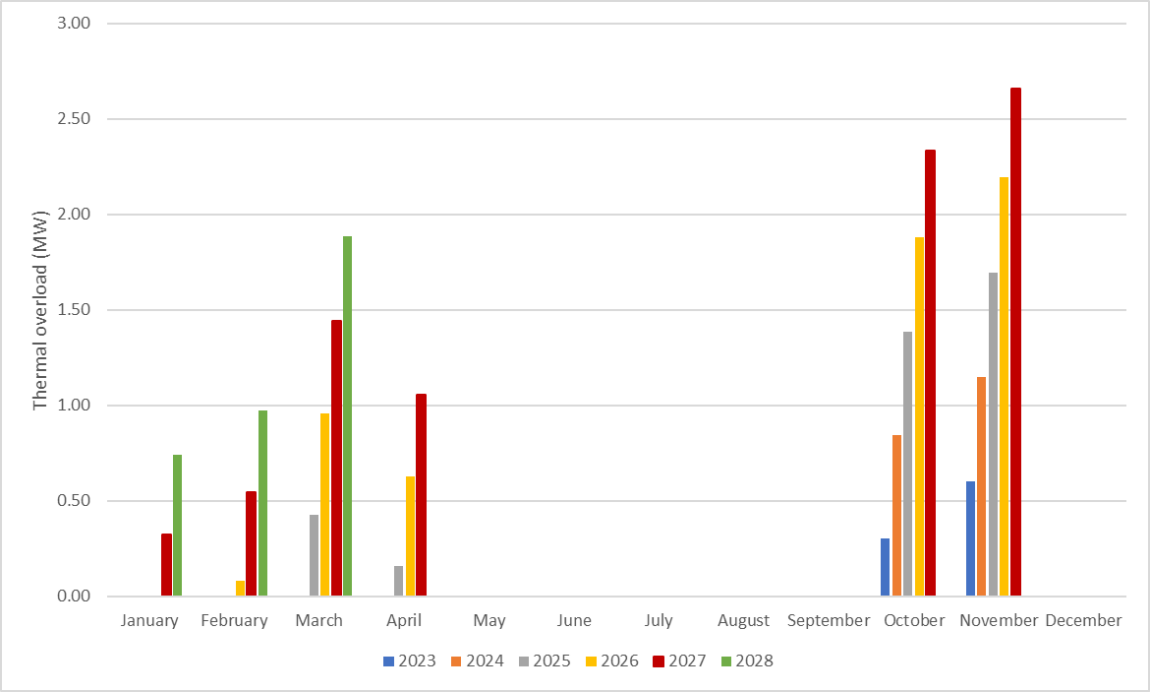

Figure 9. Monthly maximum overload on 33/11kV Hamilton transformer