Ayton Primary Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-004-CV1-EJP

Issue	Date	Comments
Issue 0.1	Feb 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	Ayton Primary Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-004-CV1		
Output	Load Index		
Cost	£1.309m		
Delivery Year	2024-2026		
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	**£1.309m**	**£m**

Technical Governance Process

Project Scope Development

IP1(S)

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

PART A – PROJECT INFORMATION

Project Title:	**Ayton Primary Reinforcement**
Project Reference:	**ED2-LRE-SPD-004-CV1**
Decision Required:	**To give concept approval for the replacement of Ayton primary transformers with higher rated units in combination with flexibility services to manage thermal constraints during the project delivery.**

Summary of Business Need:

Ayton 33/11kV primary group supplies 1,540 customers in the county of Berwickshire, part of the Scottish Borders region of SP Distribution (SPD) licence area. With the forecast uptake of Low Carbon Technologies (LCT), the group demand at Ayton primary is forecast to exceed its firm capacity by the end of RIIO-ED2 period with risk of thermal overloading on Ayton 33/11kV transformers.

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. Optioneering and design studies have been undertaken to assess the least cost technically acceptable solution.

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

The proposed scheme is to use flexibility services to manage the thermal constraint in the early years of RIIO-ED2 while the level of thermal constraint and risk hours are relatively low, and during delivery of the replacement of the 5MVA transformers with 10MVA units.

1. Contract flexibility services based on flexibility tender responses received to date
2. Replace the Ayton 5MVA transformers with 10MVA units
3. Continue annual tendering for flexibility in this area

The estimated cost for the above is £1.309m (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	**1.234**	-	0.617	0.617	-	-
SPD	CV1	Flexible Services	**0.075**	0.017	0.030	0.03	-	-
SPD	**Total**		**1.309**	**0.017**	**0.647**	**0.645**	**-**	**-**

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

Ayton 33/11 kV primary group is located in the county of Berwickshire, part of the Scottish Borders region of SP Distribution (SPD) license area. The primary group currently serves ca. 1,540 customers.

The group demand at Ayton primary is approaching the 5MVA firm capacity (FC) of the group. Our Baseline View projects a peak demand of 5.56MVA by 2028, with an expected uptake of up to 441 electric vehicles and 566 heat pumps by the end of the RIIO-ED2 period.

In order to secure supplies within the group, meet the licence obligations under Engineering Recommendation (EREC) P2/7 and to accommodate future demand growth within the area, it is proposed to use flexibility services to manage the thermal constraint in the early years of RIIO-ED2 while the level of thermal constraint and risk hours are relatively low and whilst the 5MVA transformers are replaced with 10MVA units.

The estimated cost for the above is £1.309m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

It is proposed to start the works in 2024/25 and the release capacity of 5MVA will be claimed in 2025/26 at the end of the project. In order to reduce the risk of supply, it is proposed to contract flexibility services during the project delivery.

The timing of the project is based on delivering the highest NPV, while maintaining security of supply. Detailed analysis indicates that with tendered flexibility service costs, the proposed scheme can be deferred by one year (2024/25). It is recommended to continue annual tendering for flexibility in this area to procure enough capacity and review the scheme depending on future tenders resulting competitive bids enabling to defer the proposed reinforcement.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Ayton Primary 11kV demand group. The group is connected to one leg of the 33kV Berwick Ring, which consists of 33kV circuits from Eccles to Berwick via Duns, Chirnside, Ayton and Eyemouth. The overall circuit length is significant at approximately 46km with the individual sections as follows:

- Eccles – Duns (2 circuits): 13.25km/16.34km
- Duns – Chirnside: 9.31km
- Chirnside – Ayton: 7.16km
- Ayton – Eyemouth: 4.43km
- Eyemouth – Berwick: 12.88km

Ayton primary substation is fed from Berwick and Eccles GSP via the 33kV network shown in Figure 1.

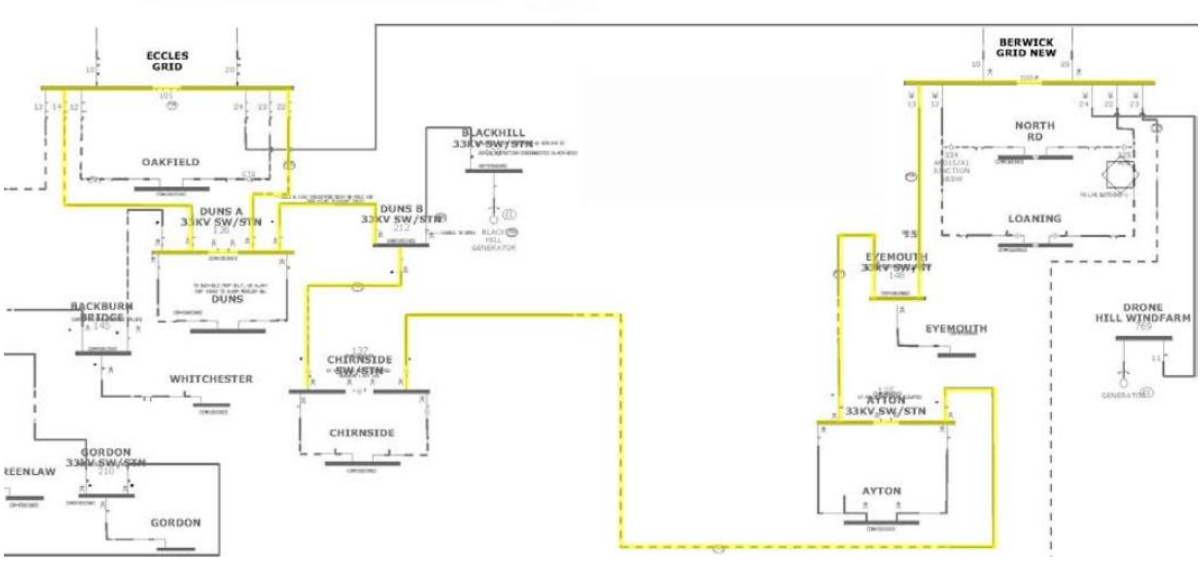

Figure 1. Existing 33kV network

The Berwick Ring supplies 7,906 customers with 1,540 supplied from Ayton primary. The existing 11kV network is located in Ayton town which is in a rural area of the Scottish Borders, comprising mainly long sections of overhead line (OHL). Ayton primary is interconnected at 11kV with Eyemouth, North Road & Chirnside substations, as shown below in Figure 2.

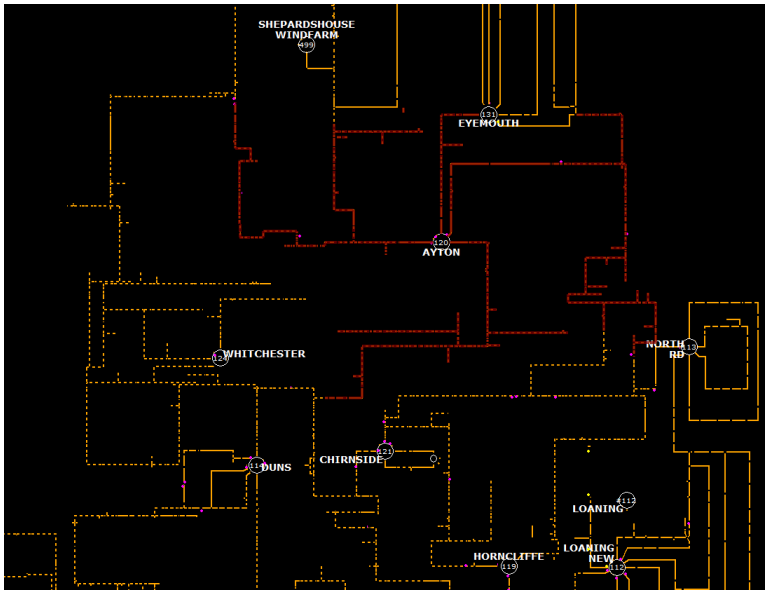

Figure 2. Existing 11kV network

2.2 Group Demand & Security of Supply

The maximum demand at Ayton primary was 4.86MVA in 2018; which places the group in a class 'B' of supply as per EREC P2/7 and must be secured for a first circuit outage (FCO).

The group is served by two 5MVA, Crompton Parkinson, 33/11kV transformers (1960). A summary of the transformer data is presented in Table 2.1.

Table 2.1. Ayton primary transformer data

	T1	T2
Manufacturer	Crompton Parkinson	Crompton Parkinson
Manufacturer Year	1960	1960
Voltage	33/11 kV	33/11 kV
Thermal Rating	5MVA	5MVA
Health Index	5	5

Based on measured data, this area of network would be unable to accommodate any sustained growth without exceeding the 5MVA FCO capacity of the Ayton group.

2.3 Embedded Generation

Embedded generation connected to the network is shown in Table 2.2.

Table 2.2. Embedded generation connected to Ayton primary

Primary	Voltage (kV)	Site	Capacity (MW)	Type	Status
Ayton	11	Brockholes Farm Wind Cluster	2.4	Onshore Wind	Connected
	11/LV	Embedded generation (<1MW)	3.7	Onshore Wind/Solar/CHP	Connected

2.4 Fault Levels

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

3 Needs Case

Our Baseline View forecasts a peak demand by 2028 of 5.56MVA, with an expected uptake of up to 441 electric vehicles and 566 heat pumps. This exceeds the Ayton primary firm capacity of 5MVA 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 are 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.

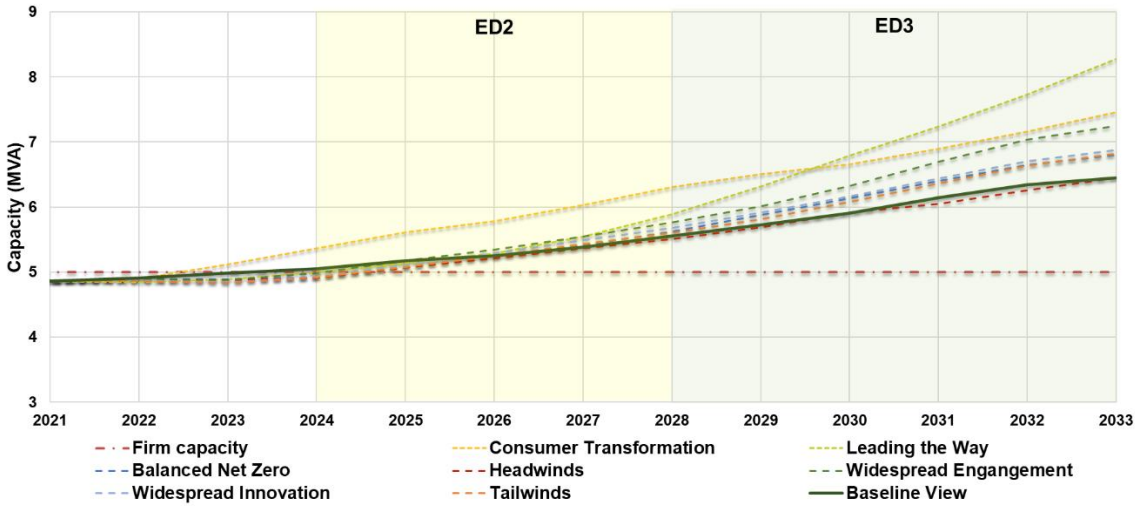

Figure 3. Demand (MVA) forecast for Ayton demand group

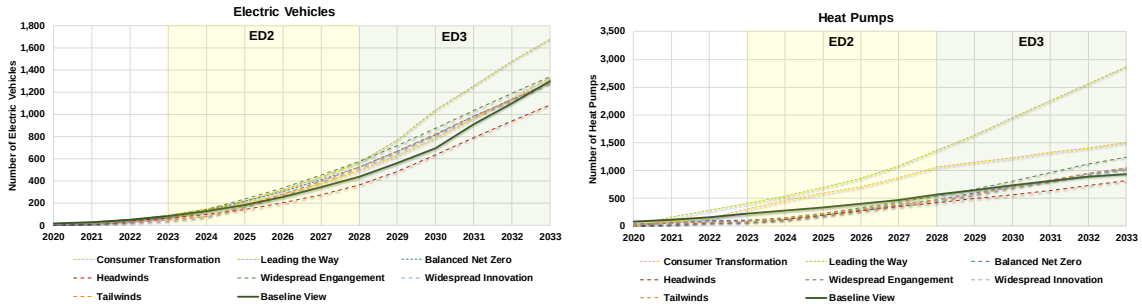

Figure 4. Forecast Electric Vehicle and Heat Pump uptakes for Ayton demand group

3.1.2 Baseline View

The Ayton group demand forecast under our Baseline scenario, along with the firm capacity and utilisation, are shown in Table 3.1 through to the end of the RIIO-ED3 period.

Table 3.1. Baseline View forecast

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	4.86	4.91	4.98	5.05	5.17	5.25	5.38	5.56	5.72	5.90	6.15	6.34	6.45
Firm Capacity (MVA)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Utilisation (%)	97	98	100	101	103	105	108	111	114	118	123	127	129
Load Index	LI3	LI3	LI4	LI5	LI5	LI5	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 Ayton 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
Ayton T1	33/11kV	N-1
Ayton T2	33/11kV	N-1

3.2.2 Voltage Constraints

There were no voltage constraints at 11kV network fed from the Ayton primary demand group.

3.2.3 EREC P2/7 – Security of Supply

Ayton primary substation has a forecast peak demand of 5.56MVA by the end of RIIO-ED2 which puts the group in a class 'B' of supply as per EREC P2/7. A class 'B' must secure the following minimum demand for a first circuit outage (FCO):

- Group demand minus 1MW must be met within 3 hours;
- Group demand must be met within repair time.

Ayton group demand has an FCO security of 5MVA. 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 Ayton 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)	138	251	375	530	743
Required Flexible Capacity (MW)	0.51	0.70	0.89	1.10	1.33

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)	Replace 5MVA transformers with 10MVA units and utilise flexibility services to reduce risk hours until work is complete	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	Utilise flexibility services to defer reinforcement into RIIO-ED3	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Install active network management (ANM) on the 11kV network to enable dynamic transfer of demand between substations	Rejected	Rejected due to wider network constraints.
(f)	Real Time Thermal Rating (innovation).	Rejected	Ayton transformers are HI5 and therefore cannot be considered for RTTR. This option is not technically viable and has been discounted.

5 Detailed Analysis & Costs

5.1 Proposed Option (Baseline) – Replace Primary Transformers and Utilise Flexibility Services

The proposed option for this scheme is to replace 5MVA transformers with 10MVA units and utilise flexibility services to manage network constraints until delivery. 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 / Innovation	Ayton Primary Reinforcement	Replace 5MVA transformers with 10MVA units Utilise flexibility services to manage network constraints until delivery	1.309	-

The proposed solution would remove the existing 5MVA transformers and replace them with new 10MVA units. It is envisaged that the transformers will be commissioned on land adjacent to the existing compound. An aerial view of the site is shown in Figure 5 and the proposed 33kV network configuration is shown in Figure 6.

A firm capacity of 10MVA would provide a 5MVA of additional thermal headroom for future load growth. Following the proposed investment solution, Ayton Demand Group would be EREC P2/7 compliant under all DFES scenarios.

Figure 5. Aerial view of Ayton primary

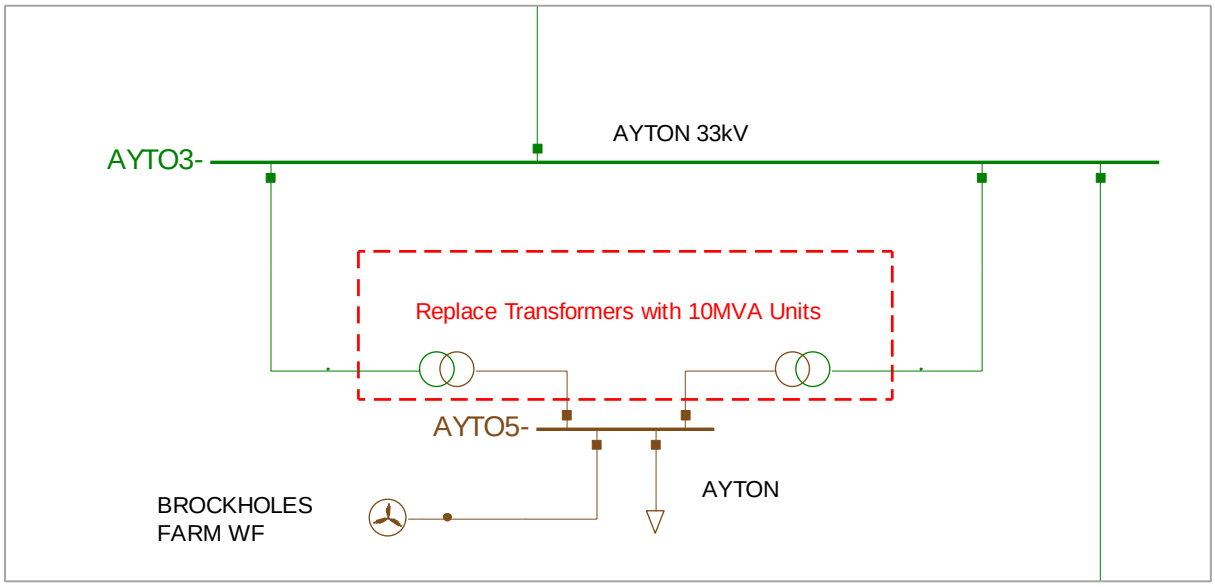

Figure 6. Schematic of the proposed 33kV network

Based on the response to the flexibility tender run in Spring 2021, flexibility as a viable option to delay reinforcement has been discounted (see section 5.2). However, the increase in capacity and cost of flexibility, due to demand growth, was considered against the benefit of deferral in each year of RIIO-ED2. This is assessed by using flexibility services to manage the constraint while the level and number of risk hours is relatively low, but to replace the transformers when efficient to do so.

Table 5.2 shows how delaying reinforcement by using received flexibility services would affect the Net Present Value (NPV).

Table 5.2. NPV when delaying reinforcement by using received flexibility services

	Start Delivery Year 1	Start Delivery Year 2	Start Delivery Year 3	Start Delivery Year 4	Start Delivery Year 5
NPV	£0.000	**£0.011**	-£0.001	-£0.052	-£0.142
		Proposed			

Considering above it is proposed to defer the reinforcement delivery by one year and start the works in 2024/25 and deliver the project in 2025/26 against which the capacity release of 5MVA will be claimed. The total of 3.5MW of capacity has been accepted between 2023-2026 in order to delay the reinforcement and support the network during the project delivery, which is shown in Table 5.3. The cost of flexibility services has been added to the proposed solution.

Table 5.3. Accepted flexible capacity from the flexibility tender run in September 2020

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Accepted Flexible Capacity (MW)	0.017	0.030	0.028	-	-

It is also recommended to continue annual tendering for flexibility in this area to procure enough capacity and review the scheme depending on future tenders resulting competitive bids enabling to defer the proposed reinforcement.

Table 5.4 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.4. Proposed option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	0.3	0.035	0.035	-
33kV UG Cable (Non Pressurised)	0.3	0.060	0.060	-
33kV Transformer (GM)	2	0.738	0.738	-
Civil Works at 33 kV & 66 kV Substations		0.150	0.150	-
Wayleaves/Easements/Land Purchase		0.050	0.050	-
Other Costs (Identify Below)		0.200	0.200	-
Flexibility Services		0.075	0.075	-
Total Costs		1.309	1.309	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Remedial works on the existing site (£70k)				
Endbox replacement/fill (£30k)				
Planning and design (£50k)				
Telecoms upgrade (£50k)				

5.2 Option 1 – Flexibility Services

Option 1 for this scheme proposes to use flexibility services to manage the thermal constraint until the Ayton 5MVA transformers are replaced at the beginning RIIO-ED3. No capital expenditure (CAPEX) is incurred during the RIIO-ED2 price control period for this option.

Table 5.5 shows the scheme summary. This option is rejected based on cost.

Table 5.5. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Ayton Primary Reinforcement	Utilise flexibility services to defer a new primary into RIIO-ED3	0.203*	-

*This option would defer a requirement for a new primary to RIIO-ED3 of £1.234m which has been included in the cost benefit analysis.

Based on the response to the flexibility tender run in Spring 2021, the required capacity for the Baseline View has been met and the flexibility as an option to delay reinforcement has been considered in this option. The total of 6.09MW of received flexible capacity has been considered between 2023-2028 which is shown in Table 5.6. The cost of flexibility services has been added to this option.

Table 5.6. Option 1 flexible capacity from the flexibility tender run in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Required Flexible Capacity for the Baseline View (MW)	0.51	0.70	0.89	1.10	1.33
Received Flexible Capacity (MW)	1.00	1.47	0.99	1.20	1.43

5.3 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.7.

Table 5.7. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Replace 5MVA transformers with 10MVA units and utilise flexibility services to reduce risk hours until work is complete	1.309
Option 1	Utilise flexibility services to defer reinforcement into RIIO-ED3	0.203*

*Note: This option would defer a requirement for a replacement of primary transformers to RIIO-ED3 of £1.234m which has been included in the cost benefit analysis.

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 replace 5MVA transformers with 10MVA units and utilise flexibility services to manage network constraints until delivery.

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-004-CV1-CBA – Ayton 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 – Replace 5MVA transformers with 10MVA units and utilise flexibility services to reduce risk hours until work is complete	**Adopted**					
Option 1 – Utilise flexibility services to defer reinforcement into RIIO-ED3		Discounted on NPV	-0.10	-0.22	-0.29	-0.35

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 £1.234m and further £0.075m 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	0.3	0.035	0.035	-
33kV UG Cable (Non Pressurised)	0.3	0.060	0.060	-
33kV Transformer (GM)	2	0.738	0.738	-
Civil Works at 33 kV & 66 kV Substations		0.150	0.150	-
Wayleaves/Easements/Land Purchase		0.050	0.050	-
Other Costs (Identify Below)		0.200	0.200	-
Flexibility Services		0.075	0.075	-
Total Costs		1.309	1.309	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Remedial works on the existing site (£70k)				
Endbox replacement/fill (£30k)				
Planning and design (£50k)				
Telecoms upgrade (£50k)				

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)	**1.234**	-	0.617	0.617	-	-
CV1(Flexible Services)	**0.075**	0.017	0.030	0.03	-	-
Total Cost	**1.309**	**0.017**	**0.647**	**0.645**	**-**	**-**

6.4 Risks

The main risk is 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.

In addition, there is a risk during delivery of this project relate to construction outages. Outages will result in load centres associated with Ayton primary substation being on single circuit risk. It is proposed that the transformer replacement be undertaken on an off-line basis. The risk will 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 security of supply risk. 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 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	441		493	571	529	364	576	524	524
HPs	566		1,058	1,357	480	420	541	478	476

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

F – Utilise accepted flexibility services
R¹ – Replace primary transformers

The proposed solution is robust across the range of future pathways. The selected solution is required under all scenarios. In all cases this solution is expected to endure beyond RIIO-ED3. The timing of the requirement is only slightly sensitive to uptake rates but is found to be required under all scenarios within the RIIO-ED2 period.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	Uncertain
RIIO-ED2 Expenditure (£m)	1.309	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 260 tonnes. The monetised embodied carbon value associated with this emission is £14.1k. 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 Ayton Primary Reinforcement programme has limited potential to impact on SPEN's Business Carbon Footprint (BCF) and on the embodied carbon resulting from the delivery of the programme. Upfront costs associated with resized assets used within the reinforcement programme (e.g. embodied carbon in the materials and emissions associated with civil engineering works) will be considered against the potential operational efficiency improvements associated with the new assets from a lifetime carbon perspective. For example, with the carbon emissions resulting from the raw materials and manufacture of a new transformer only contributing around 5-10% of its whole-life carbon impact,

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

it is entirely possible that a transformer with a higher embodied carbon footprint may have lower whole-life carbon emissions if it can operate more efficiently with fewer losses.

As network losses currently account for 95% of our BCF, even a marginal improvement in the efficiency of an EHV transformer can bring a significant reduction in lifetime losses and the resulting carbon emissions. Therefore, it is important that efficiency criteria inform the decision-making process.

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts associated of the Ayton 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 Ayton Primary Reinforcement programme will result in the consumption of resources and the generation of waste materials from end of life assets.

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

6.7.4 Biodiversity / Natural Capital

The installation of new transformers has the potential to impact on natural capital and biodiversity. In particular, the extension of the substation will result in the loss of a small area of farmland. We will minimise the area of land take required and will minimise disturbance to soils and vegetation during construction. We will replace and enhance the existing habitat, working with relevant stakeholders to identify the measures required to achieve a net gain in biodiversity and wider ecosystem services.

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

Ayton 33/11 kV primary group is located in the county of Berwickshire, part of the Scottish Borders region of SP Distribution (SPD) license area. The primary group currently serves ca. 1,540 customers.

In order to secure supplies within the group, meet the licence obligations under Engineering Recommendation (EREC) P2/7 and to accommodate future demand growth within the area, it is proposed to use flexibility services to manage the thermal constraint in the early years of RIIO-ED2 while the level of thermal constraint and risk hours are relatively low and whilst the 5MVA transformers are replaced with 10MVA units.

The estimated cost for the above is £1.309m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

It is proposed to start the works in 2024/25 and the release capacity of 5MVA will be claimed in 2025/26 at the end of the project. In order to reduce the risk of supply, it is proposed to contract flexibility services during the project delivery.

The timing of the project is based on delivering the highest NPV, while maintaining security of supply. Detailed analysis indicates that with tendered flexibility service costs, the proposed scheme can be deferred by one year (2024/25). It is recommended to continue annual tendering for flexibility in this area to procure enough capacity and review the scheme depending on future tenders resulting competitive bids enabling to defer the proposed reinforcement.

8 Appendices

Appendix 1. System Study Results

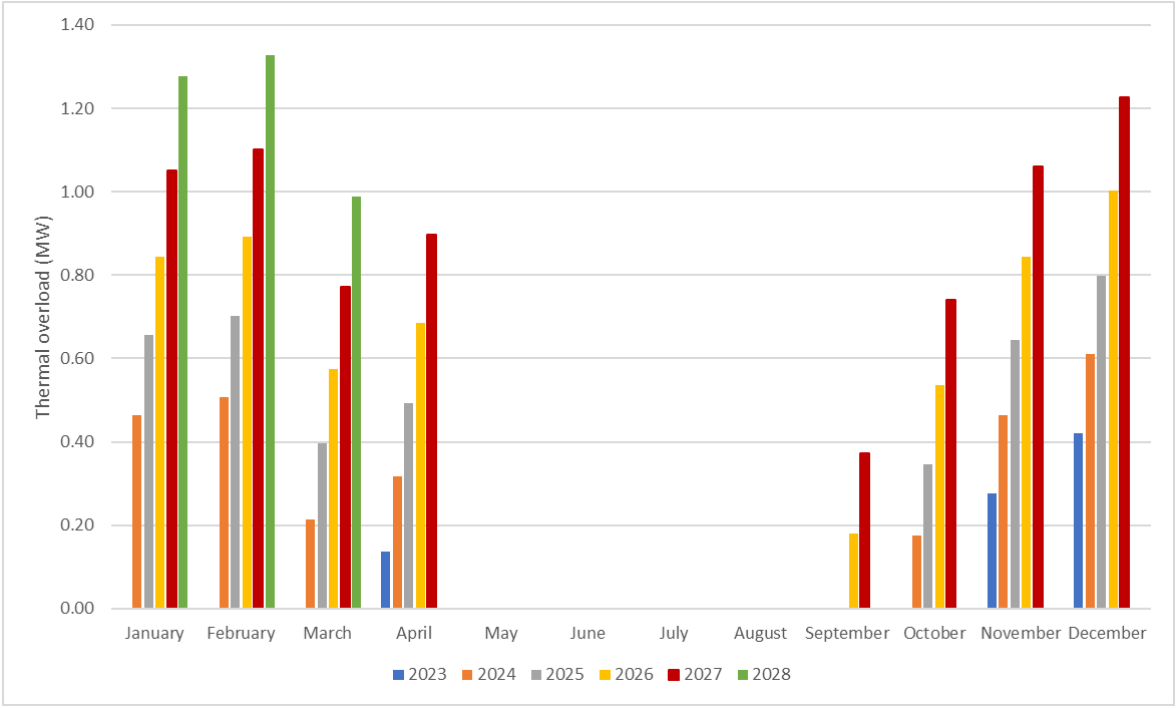

Figure 7. Monthly maximum overload on 33/11kV Ayton transformer