Stonehouse Primary Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-017-CV1-EJP

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

Scheme Name	Stonehouse Primary Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-017-CV1		
Output	Load Index		
Cost	£0.842m		
Delivery Year	2023-2025		
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	**£0.842m**	**£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:	**Stonehouse Primary Reinforcement**
Project Reference:	**ED2-LRE-SPD-017-CV1**
Decision Required:	**To give concept approval for the use of network automation to manage an N-1 11kV circuit constraint in the Stonehouse demand group.**

Summary of Business Need:

Stonehouse 33/11kV primary group is geographically located in the Lanarkshire region of SP Distribution (SPD) license area. The single transformer group supplies 2,765 customers. Stonehouse primary has firm capacity of 8MVA. The SP Energy Networks, Distribution Future Energy Scenario, Baseline View, forecasts a peak demand of 8.59MVA by 2028, including an expected uptake of up to 996 electrical vehicles and 285 heat pumps. By the end of the RIIO-ED2 price control period, Stonehouse demand group, will be a class 'B' of supply as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7.

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 carry out system reinforcement in the RIIO-ED2 price control period. Further, in order to comply with section 9 of the Electricity Act and Condition 21 of our licence obligation "to develop and maintain an efficient, coordinated and economical system for the distribution of electricity" an enduring design solution is required in order to satisfy the existing demand requirements and accommodate future load growth.

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

The proposed scheme utilises a section of de-energised 33kV overhead line (OHL), that would otherwise require to be decommissioned. The OHL will form part of a new interconnectable 11kV circuit between Stonehouse and Strathaven substations. It is proposed to establish an HV automation scheme to transfer up to 6MVA of demand to adjacent Strathaven primary under N-1 conditions. This defers £0.812m for the replacement of the 11kV switchboard, a second 33/11kV transformer, and associated installation of higher rated circuits into RIIO-ED3/ED4.

The estimated cost for the above is £0.842m (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	**0.812**	0.655	0.164	-	-	-
SPD	CV1	Flexible Services	**0.030**	0.030				
SPD	**Total**		**0.842**	**0.655**	**0.164**	**-**	**-**	**-**

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

Stonehouse 33/11kV primary group is geographically located in the Lanarkshire region of SP Distribution (SPD) license area. The single transformer group supplies 2,765 customers.

Stonehouse primary has firm capacity of 8MVA. Our Baseline View projects a peak demand of 8.59MVA by 2028, including an expected uptake of up to 996 electrical vehicles and 285 heat pumps. By the end of the RIIO-ED2 price control period, Stonehouse demand group will be a class 'B' of supply as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7.

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 utilise a section of de-energised 33kV overhead line (OHL), that would otherwise require to be decommissioned. The OHL will form part of a new interconnectable 11kV circuit between Stonehouse and Strathaven substations. It is proposed to establish an HV automation scheme to transfer up to 6MVA of demand to adjacent primaries under N-1 conditions.

The estimated cost for the above is £0.842m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

In order to facilitate market growth and reduce risk during delivery of the project, it is proposed to contract 1.5MW of flexibility services at Stonehouse primary, at a cost of £30k. It is recommended to tender annually for flexibility services 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 project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 6MVA released in 2024/25, upon completion of the proposed works.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Stonehouse Primary 11kV demand group. The existing 11kV network is located on the A71 trunk road between Edinburgh and Kilmarnock, near the towns of Hamilton, Larkhall and Strathaven. The primary is fed from Wishaw GSP via the 33kV network shown in Figure 1.

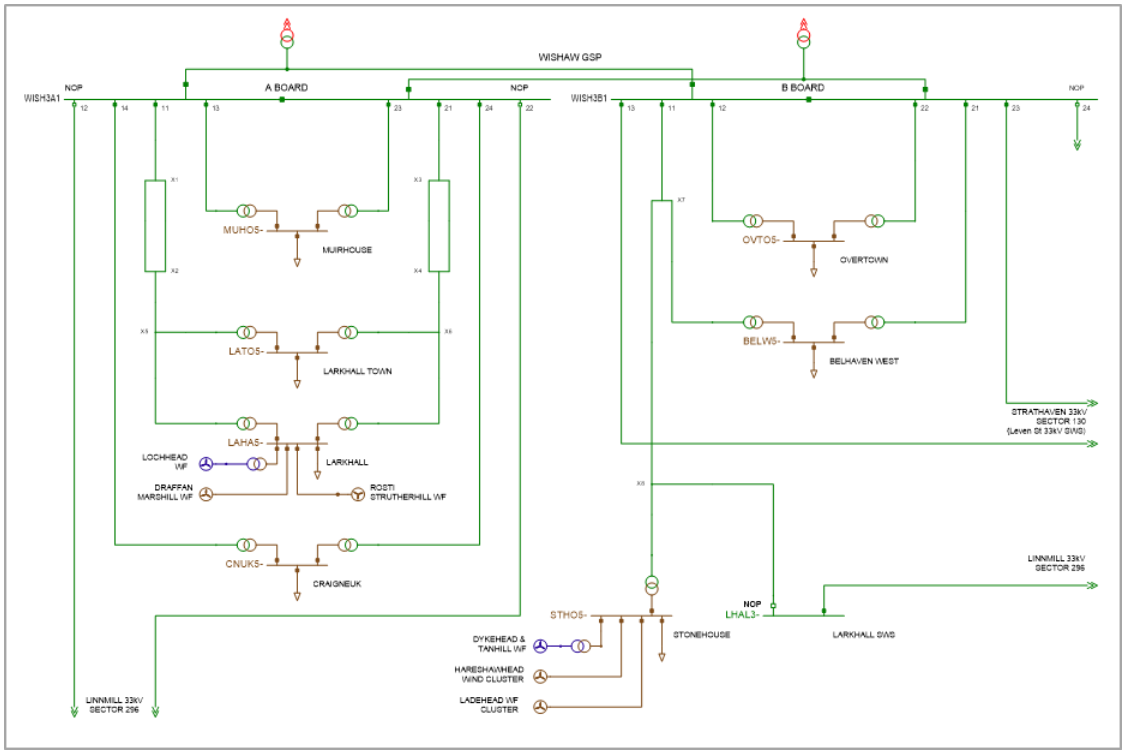

Figure 1. Existing 33kV Network

The area is a rural environment, comprising a mix of underground cable (UGC) and overhead line (OHL). Stonehouse primary is interconnectable at 11kV with Strathaven and Larkhall substations.

2.2 Group Demand & Security of Supply

The maximum measured demand on the Stonehouse 33/11kV transformer was 9.1MVA (2019); which is a class 'B' of supply as per EREC P2/7 and must be secured for a first circuit outage (FCO).

Stonehouse Primary is fed via one 33kV circuit with a summer/winter thermal rating of 19.71/20.86MVA. The group is served by a single 12/24MVA, ABB, 33/11kV transformer (2014). However, the N-1 capacity of the primary is constrained by the capacity of the 11kV interconnectable circuits between Stonehouse, Strathaven and Larkhall substations.

Based on measured data above, this area of network would be unable to accommodate any sustained growth without exceeding the 8MVA FCO capacity of the Stonehouse group.

2.3 Embedded Generation

Embedded generation connected to the network is shown in Table 2.1.

Table 2.1. Embedded generation connected to Stonehouse primary

Primary	Voltage (kV)	Site	Capacity (MW)	Type	Status
Stonehouse	11	Dykehead & Tanhill Windfarm	1.0	Onshore Wind	Connected
	11	Ladehead Wind Cluster	2.0	Onshore Wind	Connected
	11	Hareshawhead Wind Cluster	1.5	Onshore Wind	Connected
	11/LV	Embedded generation (<1MW)	9.5	Solar/Onshore Wind	Connected

2.4 Fault Levels

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

3 Needs Case

Our Baseline View forecasts a peak demand of 8.59MVA by 2028, including an expected uptake of up to 996 electrical vehicles and 285 heat pumps. This exceeds the 8MVA firm capacity of Stonehouse primary demand group by the end of RIIO-ED2.

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

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

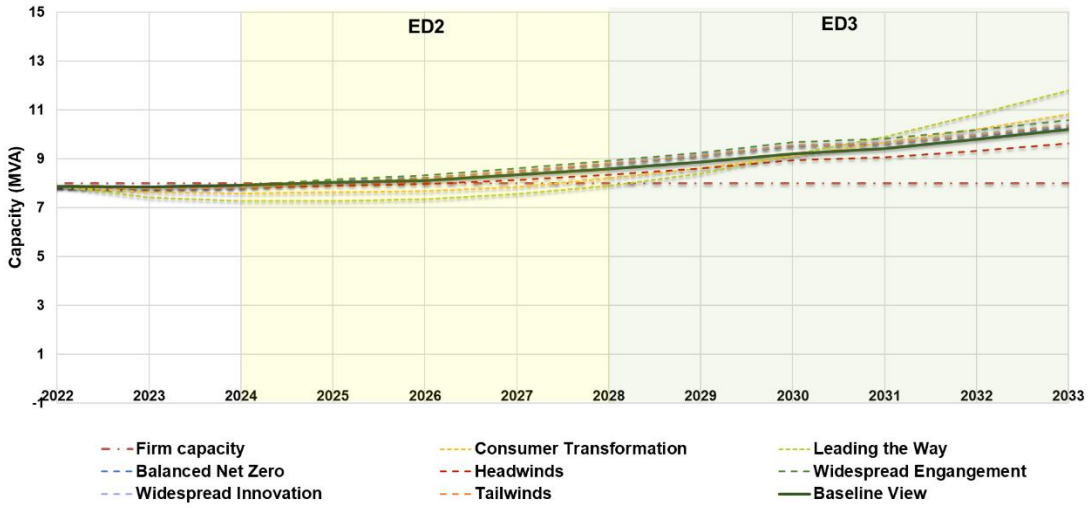

Figure 2. Demand (MVA) forecast for Stonehouse demand group

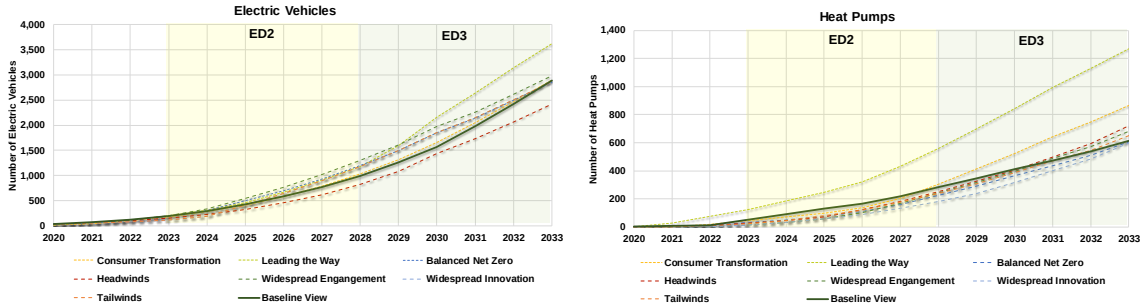

Figure 3. Forecast Electric Vehicle and Heat Pump uptakes for Stonehouse demand group

3.1.2 Baseline View

For the Stonehouse 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 for Stonehouse demand group

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	7.4	7.5	7.7	8.0	8.3	8.6	9.1	9.4	9.7	10.0	10.4	10.8
Firm Capacity (MVA)	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0
Utilisation (%)	93	94	97	100	103	108	114	117	122	125	129	135
Load Index	LI2	LI2	LI3	LI4	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 Stonehouse 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
Stonehouse Primary - Strathaven Primary 11kV Circuit[1]	33/11kV	N-1

3.2.2 Voltage Constraints

There were no voltage constraints associated with Stonehouse primary demand group.

3.2.3 EREC P2/7 – Security of Supply

Stonehouse Primary substation has a forecast peak demand of 8.59MVA by the end of RIIO-ED2. Engineering Recommendation (EREC) P2/7 defines group demands of 1MW-12MW as a class 'B' of supply.

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

- Smaller of group demand minus 1MW must be met within 3 hours;
- Group demand must be met in time to repair.

Stonehouse group demand has an FCO security of 8MVA which is the N-1 capacity of normally connected secondary interconnection. Therefore, the demand group 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 Stonehouse secondary interconnection 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. These risks are shown Table 3.3. The detailed results from the half hourly profile-based simulations are furnished in Appendix 1.

Table 3.3. Network annual hours at risk and flexible capacity tendered in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	401	517	619	827	1,124
Required Flexible Capacity (MW)	1.49	1.74	1.93	2.26	2.62

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)	Install HV automation scheme on the 11kV network to enable dynamic transfer of demand between substations	Shortlisted as **Baseline** in Detailed Analysis	
(d)	Establish a new double transformer primary substation fed from Wishaw GSP	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Establish a new double transformer primary fed from Wishaw GSP and Linnmill GSP	Shortlisted as **Option 2** in Detailed Analysis	
(f)	Utilise flexibility services to defer reinforcement into RIIO-ED3	Shortlisted as **Option 3** in Detailed Analysis	
(g)	Real Time Thermal Rating (RTTR). (Innovation)	Rejected	Loading on the 11kV network 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) – Install HV Automation Scheme on the 11kV Network

The proposed option for this scheme is to install HV automation scheme between Stonehouse and Strathaven primary demand groups to transfer up to 6MVA of demand to adjacent Strathaven primary under N-1 conditions. 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	Stonehouse Primary Reinforcement	Install HV automation scheme on the 11kV network to enable dynamic transfer of demand between substations (Innovation)	0.842	-

Stonehouse substation will connect to Strathaven substation which is approx. 6km away. An existing (de-energised) section of 33kV overhead line (OHL) which was due to be dismantled will be utilised to provide an 11kV interconnectable circuit between Stonehouse and Strathaven substations. The de-energised OHL is ca. 2km from Stonehouse primary and runs through the Strathaven Primary site. Therefore, it is proposed to connect to the de-energised OHL from Stonehouse substation via 1.5km of 11kV 300mm^2 Al cable and 0.5km of 11kV 150 AAAC OHL. BT EAD will be procured to provide comms between Stonehouse and Strathaven primary substations. New circuit breakers will be installed on the existing 11kV switchboards at Stonehouse and Strathaven primary substations. The proposed works include:

- Establish an interconnectable 11kV circuit between Stonehouse and Strathaven primary substations:
    - Install a new circuit breaker on the Stonehouse primary 11kV switchboard;
    - Connect to de-energised OHL from Stonehouse substation via 1.5km of 11kV 300mm^2 Al cable and 0.5km of 11kV 150 AAAC OHL;
    - Install a new circuit breaker on the Strathaven primary 11kV switchboard.
- Decommission 3km of de-energised 33kV OHL between Stonehouse-Tee and Larkhall switching station.
- Establish HV automation scheme, allowing dynamic transfer of load between primary groups.
- Install HV network control points to enable remote stitching of embedded generation.

A geographical view of the area with the proposed works is shown in Figure 4.

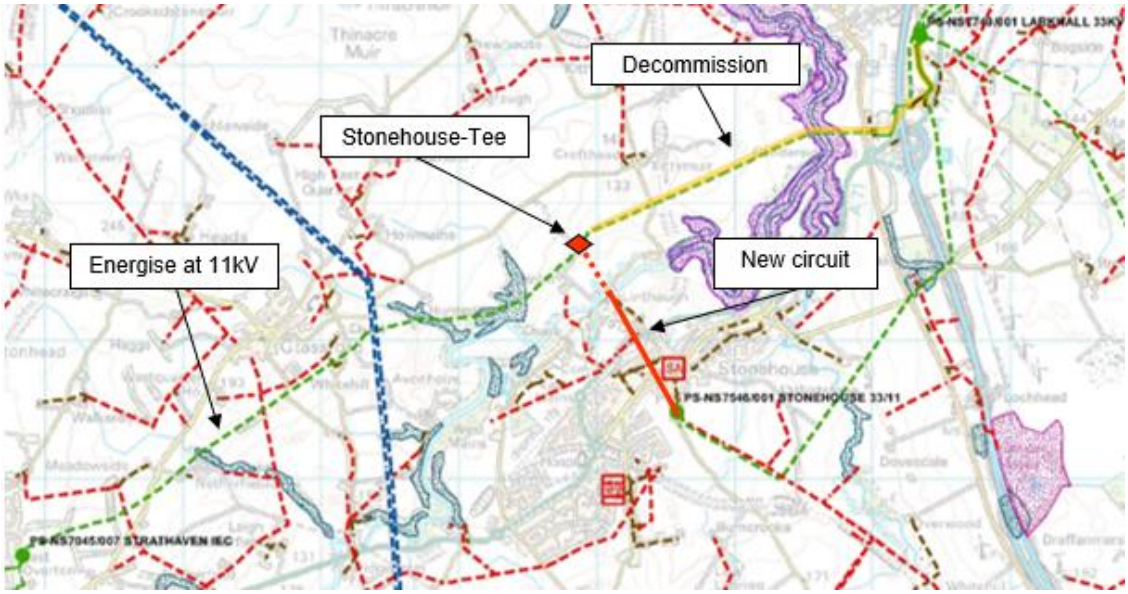

Figure 4. Geographical view of the area with the proposed works

Table 5.2 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.2. Proposed option 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)	0.5	0.013	0.013	-
6.6/11kV Poles	5	0.012	0.012	-
6.6/11kV UG Cable	1.5	0.176	0.176	-
6.6/11kV CB (GM) Primary	2	0.055	0.055	-
Civil Works at 33 kV & 66 kV Substations		0.022	0.022	-
Wayleaves/Easements/Land Purchase		0.009	0.009	-
Other Costs (Identify Below)		0.525	0.525	-
Flexibility Services		0.030	0.030	
Total Costs		0.842	0.842	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Remediation costs (£200k)				
Environmental considerations (£10k)				
BT EAD (£150k)				
Telecoms costs – modern intertripping (£20k)				
Planning and design (£30k)				
Removal of 33kV OHL (£15k)				
HV Network Control Points (£100k)				

The Baseline View forecasts an operationally manageable level of demand during project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 6MVA released in 2024/25, upon completion of the proposed works.

Based on the response to the flexibility tender run in spring 2021, flexibility as a viable option to delay reinforcement has been discounted as insufficient flexibility capacity was received for Stonehouse primary substation to remain EREC P2/7 compliant under the Baseline View. However, in order to facilitate market growth and reduce risk during project delivery, 1.5MW of capacity has been accepted at Stonehouse primary between 2023-2024, shown in Table 5-3, and the cost of accepted flexibility services has been added to the proposed solution.

Table 5-3: Network annual hours at risk and flexible capacity tendered in May 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	401	517	619	827	1,124
Required Flexible Capacity (MW)	1.49	1.74	1.93	2.26	2.62
Secured Flexible Capacity (MW)	1.5	-	-	-	-
Secured Flexible Capacity (%)	100%	-	-	-	-
Cost (£m)	0.03	-	-	-	-

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

5.2 Option 1 – Establish a New Double Transformer Primary Fed from Wishaw GSP

This option considers the establishment of a new 33/11kV 20MVA double transformer primary substation to facilitate demand growth. The new primary will be fed from Wishaw GSP and established on land across the existing Stonehouse site as there is not enough space at the current site to install the second transformer. Table 5.4 shows the scheme summary. The option would enable 12MVA additional network capacity. 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	Stonehouse Primary Reinforcement	Establish a new primary substation fed from Wishaw GSP	2.445	-

A new 8-panel 11kV switchboard and a new 20MVA transformer will be installed on land across from the existing Stonehouse site. The existing 33/11kV 12/24MVA transformer will be relocated to the new site. The second 33kV 9km circuit will be laid between the new Stonehouse No. 2 transformer and Wishaw GSP where a new 33kV circuit breaker will be installed. Option 1 33kV network configuration in shown Figure 5.

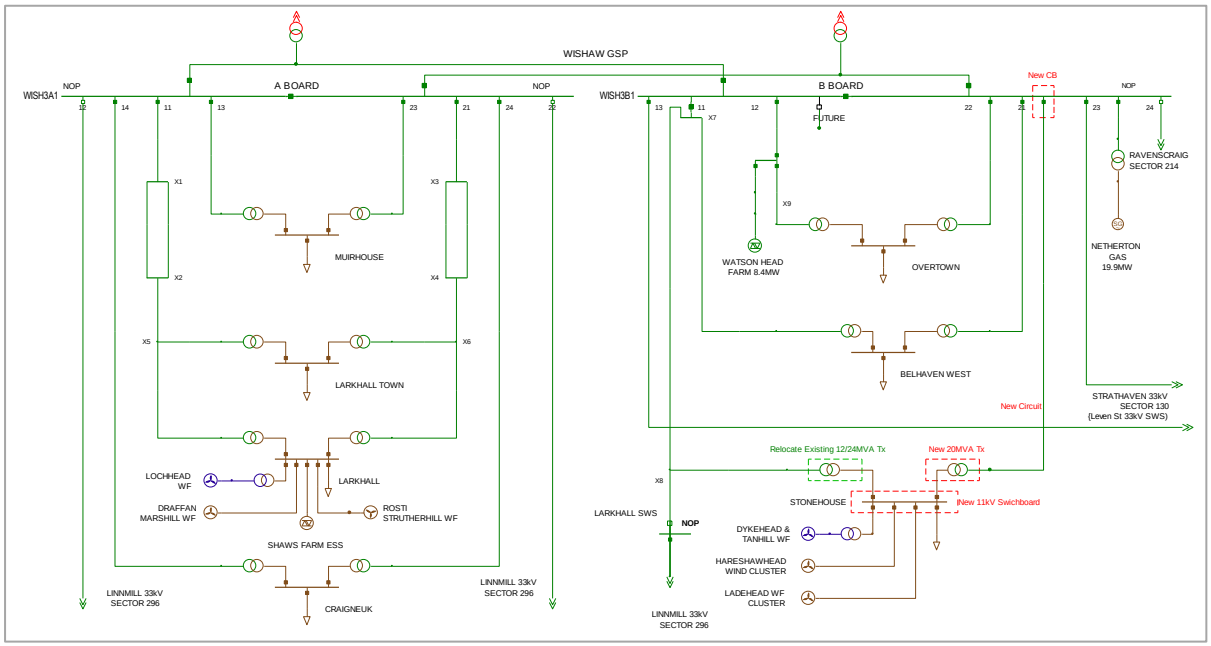

Figure 5. Schematic of Option 1 33kV network

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 CB (GM) Primary	8	0.222	0.222	-
33kV OHL (Pole Line) Conductor	6.5	0.170	0.170	-
33kV Pole	65	0.194	0.194	-
33kV UG Cable (Non Pressurised)	2.5	0.499	0.499	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	1	0.167	0.167	-
33kV Transformer (GM)	1	0.369	0.369	-
Pilot Wire Overhead	6.5	0.175	0.175	-
Pilot Wire Underground	2.5	0.277	0.277	-
Civil Works at 33 kV & 66 kV Substations		0.170	0.170	-
Wayleaves/Easements/Land Purchase		0.071	0.071	-
Other Costs (Identify Below)		0.131	0.131	-
Total Costs		2.445	2.445	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£30k)				
Telecoms costs – modern intertripping (£20k)				
Environmental considerations (£45k)				
RTU/SCADA (£5k)				
Remote end protection (£21k)				
33kV telecoms upgrade (£10k)				

5.3 Option 2 – Establish a New Double Transformer Primary Establish fed from Wishaw GSP and Linnmill GSP

This option considers the establishment of a new 33/11kV 20MVA double transformer primary substation to facilitate demand growth. The new primary will be fed from Wishaw GSP and Linnmill GSP and established on land across the existing Stonehouse site as there is no enough space at the current site to install the second transformer. Table 5.4 shows the scheme summary. The option would enable 12MVA additional network capacity. This option is not considered to offer value for money and has been discounted.

Table 5.6. Option 2 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Stonehouse Primary Reinforcement	Establish a new double transformer primary fed from Wishaw GSP and Linnmill GSP	1.730	-

A new 8-panel 11kV switchboard and a new 20MVA transformer will be installed on land across from the existing Stonehouse site. The existing 33/11kV 12/24MVA transformer will be relocated to the new site. The second 33kV 2.5km circuit will be laid between the new Stonehouse No. 2 transformer and Larkhall 33kV switching station which is fed from Linmill GSP. A new 33kV circuit breaker will be installed at Larkhall 33kV switching station. The new No. 2 transformer will be run normally open to ensure Wishaw GSP and Linnmill GSP are not run in parallel. An auto changeover scheme will be deployed, switching supply from Wishaw GSP, to Linnmill GSP, for the loss of Stonehouse No.1 Transformer. Option 2 33kV network configuration in shown Figure 5.

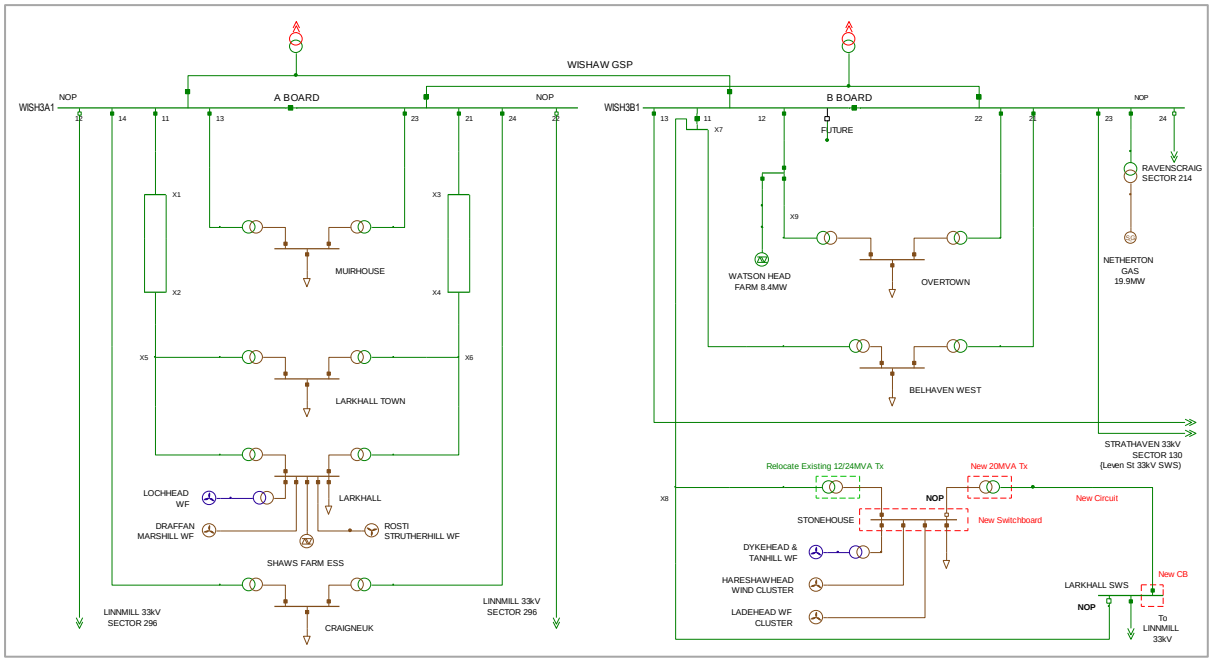

Figure 6. Schematic of Option 2 33kV network

Table 5.5 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 CB (GM) Primary	8	0.222	0.222	-
33kV OHL (Pole Line) Conductor	0.5	0.013	0.013	-
33kV Pole	5	0.015	0.015	-
33kV UG Cable (Non Pressurised)	2	0.399	0.399	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	1	0.167	0.167	-
33kV Transformer (GM)	1	0.369	0.369	-
Pilot Wire Overhead	0.5	0.013	0.013	-
Pilot Wire Underground	2	0.222	0.222	-
Civil Works at 33 kV & 66 kV Substations		0.170	0.170	-
Wayleaves/Easements/Land Purchase		0.041	0.041	-
Other Costs (Identify Below)		0.099	0.099	-
Total Costs		1.730	1.730	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£30k)				
Telecoms costs – modern intertripping (£20k)				
Environmental considerations (£12.5k)				
RTU/SCADA (£5k)				
Remote end protection (£21k)				
33kV telecoms upgrade (£10k)				

5.4 Option 3 – Flexibility Services

This option considers the feasibility of managing the overload by contracting with up to 10.05MW of flexibility services which is shown in Table 5.8. These services would contract with third parties to control the down demand (or increase generation) in the relevant timeframes to avoid risk of overload. Based on these requirements, flexibility services will be tendered in 2021, to test the market for provision of services between 2023-28 period.

Table 5.8. Network annual hours at risk and required flexible capacities for Stonehouse demand group

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Required Flexible Capacity (MW)	1.49	1.74	1.93	2.27	2.62

Table 5.9 shows the scheme summary.

Table 5.9. Option 3 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Innovation	Stonehouse Primary Reinforcement	Utilise flexibility services to defer a new primary into RIIO-ED3	0.376*	-

*This option would defer a requirement for a new primary to RIIO-ED3 of £0.812m which has been included in the cost benefit analysis.

The cost of flexibility used in the CBA has been estimated based the average bid price (£/MWh) received in all SPD flexibility tenders throughout the flexibility tender run in Spring 2021. Even with this optimistic cost for flexibility, the level of constraint and hours at risk make the flexibility solution a lower Net Present Value (NPV) than the traditional option.

Flexibility services will still be sought to test the market and establish if, as the market matures, the cost associated with flexibility will reduce. In the interim, this option has been discounted based on NPV.

5.5 Options Cost Summary Table

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

Table 5.10. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	HV automation scheme that transfers demand to Strathaven primary under N-1	0.842
Option 1	Establish a new a new double transformer primary substation fed from Wishaw GSP	2.445
Option 2	Establish a new double transformer primary fed from Wishaw GSP and Linnmill GSP	1.730
Option 3	Utilise flexibility services to defer reinforcement into RIIO-ED3	0.376*

*Flexibility has been calculated based on the average £/MWh bid received in 2021 for other sites. This option would defer a requirement for a new primary to RIIO-ED3 of £0.812 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 establish an HV automation scheme between Stonehouse and Strathaven primary demand groups.

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-017-CV1-CBA – Stonehouse 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 – HV automation scheme that transfers demand to Strathaven primary under N-1	**Adopted**					
Option 1 – Establish a new double transformer primary substation fed from Wishaw GSP	Rejected	Discounted on NPV	-1.07	-1.41	-1.62	-1.77
Option 2- Establish a new double transformer primary fed from Wishaw GSP and Linnmill GSP	Rejected	Discounted on NPV	-0.62	-0.82	-0.93	-1.02
Option 3- Utilise flexibility services to defer a new primary into RIIO-ED3	Rejected	Discounted on NPV	-0.12	-0.29	-0.39	-0.47

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 £0.842m.

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 OHL (Conventional Conductor)	0.5	0.013	0.013	-
6.6/11kV Poles	5	0.012	0.012	-
6.6/11kV UG Cable	1.5	0.176	0.176	-
6.6/11kV CB (GM) Primary	2	0.055	0.055	-
Civil Works at 33 kV & 66 kV Substations		0.022	0.022	-
Wayleaves/Easements/Land Purchase		0.009	0.009	-
Other Costs (Identify Below)		0.525	0.525	-
Flexibility Services		0.030	0.030	
Total Costs		0.842	0.842	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Remediation costs (£200k)				
Environmental considerations (£10k)				
BT EAD (£150k)				
Telecoms costs – modern intertripping (£20k)				
Planning and design (£30k)				
Removal of 33kV OHL (£15k)				
HV Network Control Points (£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)	**0.812**	0.655	0.164	-	-	-
CV1 (Flexible Service)	**0.030**	0.030				
Total Cost	**0.842**	**0.655**	**0.164**	**-**	**-**	**-**

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 Stonehouse primary substation 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 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 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 for Stonehouse demand group. 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 for Stonehouse demand group

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	996		1,031	1,186	1,195	823	1,300	1,184	1,184

HPs	285		305	557	224	249	240	182	237

*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	R[I]								
Consumer Transformation							R[I]							
Leading the Way								R[I]						
Balanced Net Zero Pathway					F	R[I]								
Headwinds						R[I]								
Widespread Engagement					F	R[I]								
Widespread Innovation						R[I]								
Tailwinds						R[I]								

R[I] – Establish an HV automation scheme between Stonehouse and Strathaven primary demand groups
F – Utilise flexibility services

The proposed solution is robust across the range of pathways. In all cases this solution is expected to endure beyond RIIO-ED3. 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. Under higher uptake scenarios, flexibility services may be required in the early years of RIIO-ED2 to manage the high loadings whilst the interconnectable 11kV circuit is in delivery.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	**Uncertain**
RIIO-ED2 Expenditure (£m)	0.842	+0.077
Comment	Proposed option	Flexibility services

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 13.4 tonnes. The monetised embodied carbon value associated with this emission is £0.6k. 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 Stonehouse Primary Reinforcement programme has the potential to impact on the embodied carbon resulting from the delivery of the programme. There is likely to be little or no impact on SPEN's Business Carbon Footprint (BCF).

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts associated of the Stonehouse 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.

6.7.3 Resource Use and Waste

The Stonehouse Primary Reinforcement programme will result in the consumption of resources and the generation of waste materials from end of life assets. However, by retaining an existing de-energised section of 33kV OHL which was due to be dismantled, the quantity of waste produced, and the quantity of new materials required has been reduced.

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 Stonehouse Primary Reinforcement programme will affect both developed sites containing existing assets and undeveloped sites. We will minimise the area of landtake required and will minimise

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

disturbance to soils and vegetation during construction. We will also work 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 and OHL equipment 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

Stonehouse 33/11kV primary group is geographically located in the Lanarkshire region of SP Distribution (SPD) license area. The single transformer group supplies 2,765 customers.

Stonehouse primary has firm capacity of 8MVA. Our Baseline View projects a peak demand of 8.59MVA by 2028, including an expected uptake of up to 996 electrical vehicles and 285 heat pumps. By the end of the RIIO-ED2 price control period, Stonehouse demand group will be a class 'B' of supply as per EREC P2/7.

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:

- Establish an interconnectable 11kV circuit between Stonehouse and Strathaven primary substations:
    - Install a new circuit breaker on the Stonehouse primary 11kV switchboard;
    - Connect to de-energised OHL from Stonehouse substation via 1.5km of 11kV 300mm^2 Al cable and 0.5km of 11kV 150 AAAC OHL;
    - Install a new circuit breaker on the Strathaven primary 11kV switchboard.
- Decommission 3km of de-energised 33kV OHL between Stonehouse-Tee and Larkhall switching station.
- Establish HV automation scheme, allowing dynamic transfer of load between primary groups.
- Install HV network control points to enable remote stitching of embedded generation.

The estimated cost for the above is £0.842m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

In order to facilitate market growth and reduce risk during project delivery, it is proposed to contract 1.5MW of flexibility services at Stonehouse primary, at a cost of £30k. It is recommended to tender annually for flexibility services 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 project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 6MVA released in 2024/25, upon completion of the proposed works.

8 Appendices

Appendix 1. System Study Results

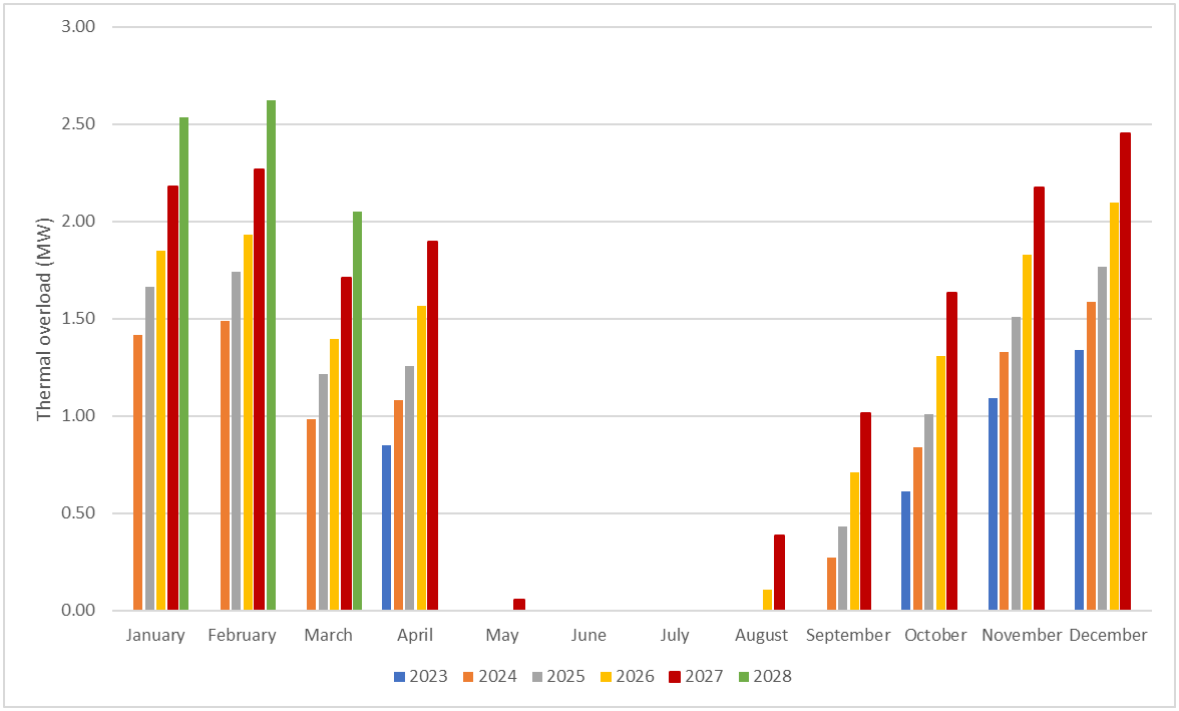

Figure 7. Monthly maximum overload on the Stonehouse secondary interconnection