Redhouse GSP Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-022-CV1-EJP

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

Scheme Name	Redhouse GSP Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-022-CV1		
Output	Load Index		
Cost	£0.139m		
Delivery Year	2023-2028		
Reporting Table	CV1		
Outputs included in ED1	~~Yes~~/No		
Business Plan Section	Develop the Network of the Future		
Primary Annex	Annex 4A.2: Load Related Expenditure Strategy: Engineering Net Zero Annex 4A.6: DFES		
Spend Apportionment	**ED1**	**ED2**	**ED3**
	£m	**£0.139m**	**£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:	**Redhouse GSP Reinforcement**
Project Reference:	**ED2-LRE-SPD-022-CV1**
Decision Required:	**To give concept approval the use of flexibility services to manage a thermal constraint on the Redhouse 60MVA transformer.**

Summary of Business Need:

Redhouse 132/33kV GSP is located in the Central and Fife district of SP Distribution (SPD), providing supplies to ca. 22,073 customers, with a firm capacity of 60MVA.

The Distribution Future Energy Scenarios (DFES) forecast a peak demand of 62.5MVA by 2028, with an expected uptake of 3,968 electrical vehicles and 1,898 heat pumps by the end of the RIIO-ED2 period.

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:

To manage the thermal constraint at Redhouse GSP throughout RIIO-ED2, it is proposed to defer conventional reinforcement by managing the thermal constraint through the RIIO-ED2 period using flexibility services.

The estimated cost for the above is £0.139m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. The proposed solution would defer a conventional reinforcement on the SP Transmission system of £2.811m which would include the replacement of the 60MVA grid transformer.

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	**0.139**	0.005	0.008	0.010	0.030	0.087
SPD	**Total**		**0.139**	**0.005**	**0.008**	**0.010**	**0.030**	**0.087**

PART B – PROJECT SUBMISSION

Proposed by	Milana Plecas	Signature	Milana Plecaš	Date: 30/11/2021
Endorsed by	Russell Bryans	Signature	[signature]	Date: 30/11/2021

PART C – PROJECT APPROVAL

Approved by	Malcolm Bebbington	Signature	[signature]	Date: 30/11/2021

Contents

1 Introduction

Redhouse 132/33kV GSP is located 3km north of Kirkcaldy in the Central and Fife district of SP Distribution (SPD), providing supplies to ca. 22,073 customers.

The primary drivers for this investment are insufficient thermal headroom and security of supply risk. Redhouse GSP is forecast to exceed its firm capacity of 60MVA under all Distribution Future Energy Scenarios (DFES) and Climate Change Committee (CCC) scenarios. Our Baseline View forecasts a peak demand of 62.5MVA by 2028, with an expected uptake of up to 3,968 electrical vehicles and 1,898 heat pumps by the end of the RIIO-ED2 period.

In order to secure supplies, meet licence obligations under EREC P2/7 and accommodate future demand growth within the area, it is proposed to defer a conventional reinforcement by managing the thermal constraint through the RIIO-ED2 period by using flexibility services based on flexibility tender responses that have been received to date. The proposed solution would defer a conventional reinforcement on the SP Transmission system of £2.811m which would include the replacement of the 60MVA grid transformer.

The proposed option is an innovative solution of procuring flexibility services from the market throughout the RIIO-ED2 period.

The estimated cost for the above is £0.139m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

2 Background Information

2.1 Existing / Authorised Network

Redhouse GSP supplies four primary substations. These are Redhouse, Chapel, Birrel St Wynd and Pitteuchar. The Redhouse network is a mixture of urban and rural environments, comprising a mix of underground cable (UGC) and overhead line (OHL). Redhouse GSP is interconnectable at 33kV with Leven GSP, Glenniston GSP and Glenrothes GSP. The authorised network is shown in Figure 1.

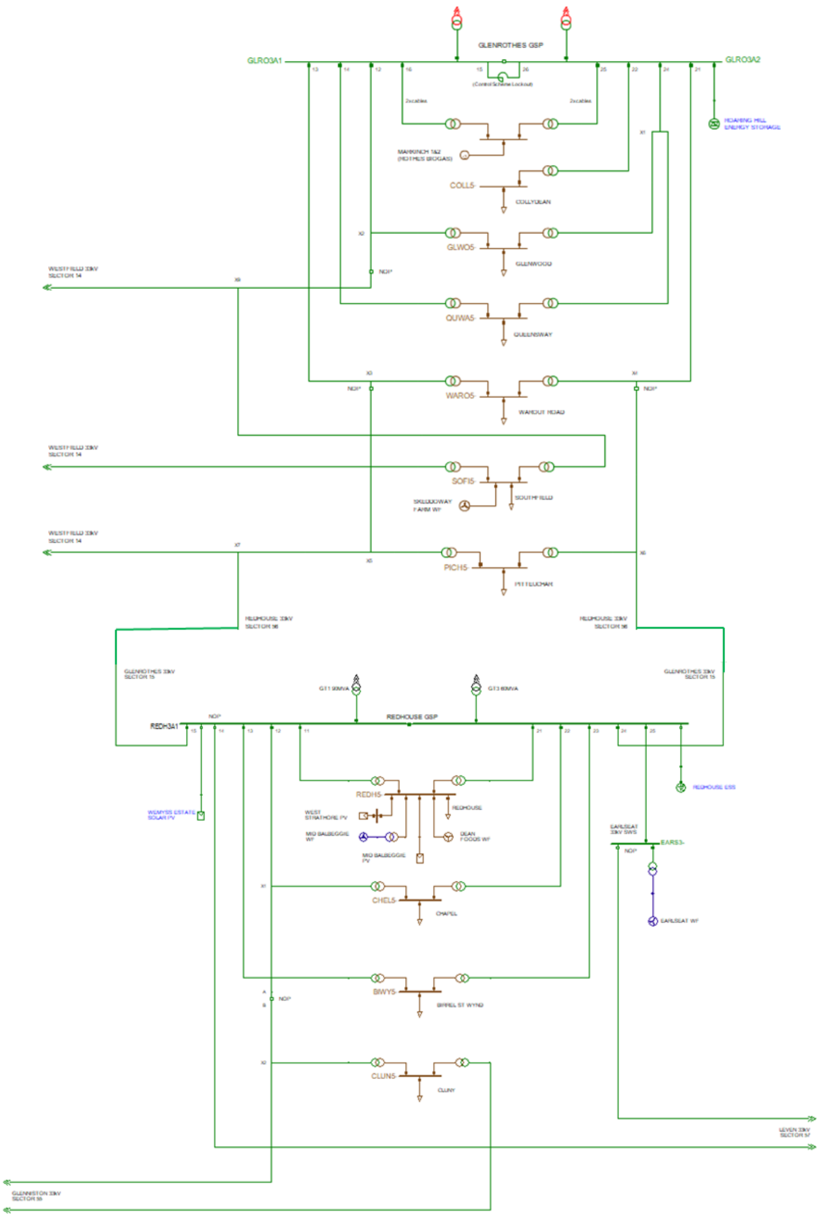

Figure 1. Authorised 33kV Network

Redhouse GSP has an indoor 33kV switchboard comprising of 15 Siemens 8DA10 gas circuit breakers (CBs). The switchboard was commissioned in 2003 and is HI1. It is arranged as two transmission incomers, one distribution bus-section, 10 distribution feeder CBs and two spare CBs.

The two-section 33kV busbar has a transmission system infeed onto each half from two 132/33kV grid transformers.

2.2 Group Demand & Security of Supply

The existing Redhouse GSP network is class 'C' of supply as per Engineering Recommendation (EREC) P2/7. The group is served by two 132/33 kV grid transformers (GTs), GT1 of 90MVA and GT3 of 60MVA. The firm capacity (N-1) of Redhouse GSP is 60MVA.

Redhouse GSP has the following interconnectors for supporting N-1 and N-2 contingencies:

- two 33kV interconnectors to Leven GSP via Methilhill primary (Normally Open Points (NOPs) at Redhouse GSP)
- two 33kV interconnector to Glenniston GSP via Linton Lane and Cluny primaries (NOP at Redhouse GSP)
- two 33kV interconnectors to Glenrothes GSP via Pitteuchar primary (NOP at Glenrothes GSP)

2.3 Embedded Generation

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

Table 2.1. Embedded generation at Redhouse GSP

GSP	Voltage (kV)	Site	Export capacity (MW)	Import capacity (MW)	Type	Status
Redhouse	11	Earlseat Windfarm	16	-	Onshore Wind	Connected
	33	Middle Balbeggie Solar Park	3.8	-	Photovoltaic	Connected
	33	Middle Balbeggie Windfarm	6.4	-	Onshore Wind	Connected
	11	West Strathore Solar Park	4.5	-	Photovoltaic	Connected
	11/LV	Dean Foods Wind	1.5	-	Onshore Wind	Connected
	11	Redhouse ESS	16	16 (firm)	Battery	Connected
	33	Wemyess Estate PV	50	-	Photovoltaic	Contracted
	33	Redhouse Small Holding Gas	40	-	Gas	Terminated
	33	Dunnikier DBESS	29.9	20 (non-firm)	Gas/Battery	Terminated
	Total		90.9	30		

2.4 Fault Levels

Studies indicate that with the authorised customer connections there are no fault level issues at Redhouse GSP. Table 2.2 shows the 33kV 3-phase and 1-phase fault levels as a percentage of the lowest of switchgear ratings / design limits at Redhouse GSP including connected and contracted generation.

Table 2.2. Redhouse GSP fault levels including connected and contracted generation

Substation Name	Design Rating (kA)		3-phase Fault Levels (kA)		1-phase Fault Levels (kA)		Max 3-phase and 1-phase Duty (%)	
	Make	Break	Make	Break	Make	Break	Make	Break
Redhouse GSP	50.00	17.50	42.62	15.62	3.75	2.6	**85.24**	**89.26**

3 Needs Case

Our Baseline View forecasts a peak demand by 2028 of 62.5MVA, with an expected uptake of up to 3,968 electrical vehicles and 1,898 heat pumps. This exceeds Redhouse GSP firm capacity of 60MVA 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 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 scenario range considers the range of Net Zero compliant scenarios developed by us, the Electricity System Operator (ESO), and the Climate Change Committee. 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.

The connected 16MW Redhouse ESS battery has a firm connection agreement with SP Transmission and its import capacity is not constrained in an N-1 situation. The peak demand forecast based on the SPD Distribution Future Energy Scenarios, including the demand from the connected battery, is depicted in Figure 2. The anticipated total electric vehicle and heat pump uptakes based on the future energy scenarios are depicted in Figure 3.

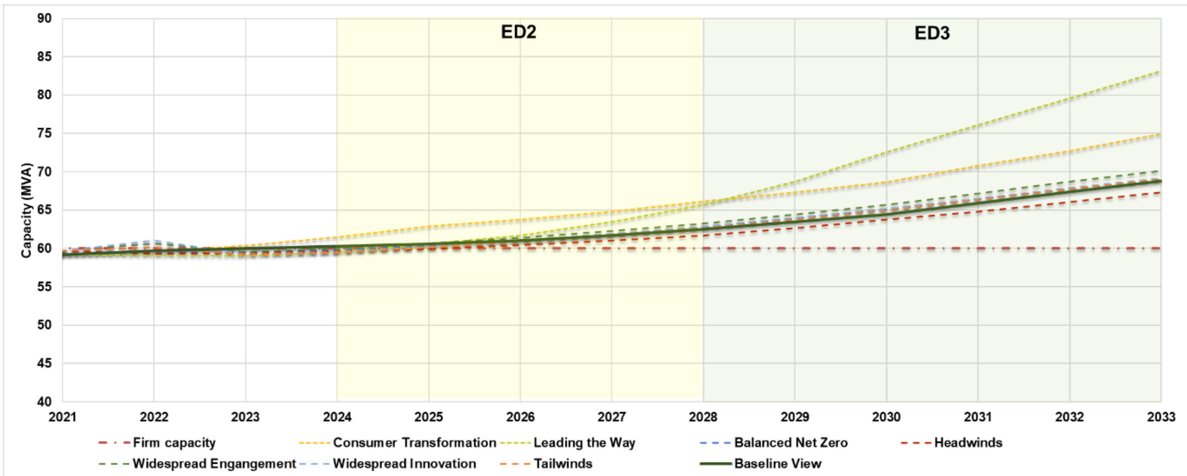

Figure 2. Demand (MVA) forecast for Redhouse GSP demand group

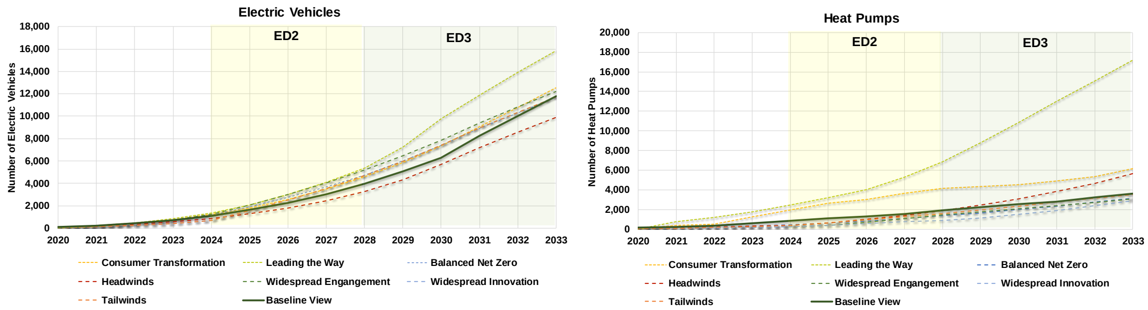

Figure 3. Forecast Electric Vehicle and Heat Pump uptakes for Redhouse GSP demand group

3.1.2 Baseline View

For the Redhouse GSP 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	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	59.2	59.7	60.0	60.3	60.6	61.1	61.7	62.5	63.5	64.4	65.9	67.4	68.8
Firm Capacity (MVA)	60	60	60	60	60	60	60	60	60	60	60	60	60
Utilisation (%)	99	100	100	100	101	102	103	104	106	107	110	112	115

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 Redhouse 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 132/33kV network level. No other thermal constraints were identified on the 33kV groups.

Table 3.2. Thermal constraints at 275/33kV level

Network Item	Voltage	Outage
Redhouse GT3	132/33kV	N-1

3.2.2 Voltage Constraints

No other voltage constraints observed in the group under intact or outage conditions on the 33kV network groups.

3.2.3 EREC P2/7 – Security of Supply

Redhouse GSP substation has a forecast peak demand of 62.5MVA by the end of RIIO-ED2 which puts the group in class 'D' of supply as per EREC P2/7.

Redhouse GSP group demand has a first circuit outage security of 60MVA which is insufficient to secure the forecast demand. Without mitigation this site is predicted to become non-compliant with EREC P2/7 during the RIIO-ED2 price control period.

3.2.4 Fault Level Constraints

No fault level constraints were observed in the group with the authorised network including contracted generation and forecast load growth.

3.2.5 Flexibility Services

In order to manage the network risk and security of supply, our assessment indicates that the risk of thermal overload on the 132/33kV Redhouse GT3 grid transformer and security of supply constraints in the group starts from the year 2023/24 throughout to the year 2028 for the most onerous scenario. 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 required flexible capacities for the most onerous scenario

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	13	15	19	41	90
Required Flexible Capacity (MW)	1.62	2.09	2.13	2.95	3.86

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 and flexibility services.

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, as the Redhouse GSP group will move from a class 'C' into a class 'D' of supply within RIIO-ED2.
(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 60MVA grid transformer with a 90MVA unit	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)	Move demand into adjacent GSP by relocation of NOPs and upgrade of 33kV circuits	Shortlisted as **Option 2** in Detailed Analysis	
(f)	Utilise interconnection with adjacent group	Rejected	Closing an interconnector in N-1 situation at Redhouse GSP would introduce a fault level issue at the interconnected GSPs.

5 Detailed Analysis & Costs

5.1 Proposed Option (Option 1) – Flexibility Services

The proposed option is to defer a conventional reinforcement by managing the thermal constraint through the RIIO-ED2 period by using flexibility services based on flexibility tender responses that have been received to date. 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	Redhouse GSP Reinforcement	Utilise flexibility services to defer reinforcement into RIIO-ED3	0.139	-

Based on the response to the flexibility tender run in September 2020, the required capacity for the Baseline View has been met and the anticipated cost of flexibility service contract for the complete RIIO-ED2 period will be £0.139m for service utilisation charges. The total of 12.65MW of received flexible capacity has been accepted between 2023-2028 which is shown in Table 5.2

Table 5.2. Proposed option flexible capacity from the flexibility tender run in September 2020

Year	2023 /24	2024 /25	2025 /26	2026 /27	2027 /28
Required Flexible Capacity for the Baseline View (MW)	0.21	0.52	0.98	1.62	2.42
Accepted Flexible Capacity (MW)	1.62	2.09	2.13	2.95	3.86

Considering the scale of network risk profile and based on the response to the flexibility tender, it is proposed to defer the conventional reinforcement into the RIIO-ED3 price control period utilising the flexibility services potential in Redhouse GSP group.

The proposed solution would defer a conventional reinforcement on the SP Transmission system of £2.811m which would include the replacement of the 60MVA grid transformer. The exit charges associated with this have been included in the CBA from 2031 onwards, in addition to the £0.139m in the summary above.

5.2 Baseline – New 90MVA grid transformer

This option involves replacement of the existing GT3 60MVA grid transformer with a new 90MVA unit in 2026. SP Distribution would submit a Modification Application (£38k) to NGESO to request an increase in the firm capacity of Redhouse GSP in 2023/24. Table 5.3 shows the scheme summary. This option would enable 30MVA of additional network capacity. This option is rejected based on cost.

This option was considered in SP Transmission RIIO-T2 Engineering Justification Paper (EJP), Redhouse GSP Upgrade (SPT20091). Although the SPT paper had a fault level reinforcement driver, the end solution would be the same in terms of the thermal constraint at Redhouse GSP.

Table 5.3. Baseline Option summary

Category	Scheme Name	Scheme Summary	Reporting Table	RIIO-ED2 Contribution (£m)	Post RIIO-ED2 (£m)	Customer Contribution (£m)
Conventional	Redhouse GSP Reinforcement	Replace 60MVA grid transformer with a 90MVA unit	CV1 Expenditure	0.038	-	-
			CV4 Expenditure	0.602	5.729	-

There are no SP Distribution works for this solution apart from a ModApp fee which is included within the CV1 expenditure.

The SP Transmission works for this solution involves the installation of a 90MVA 132/33kV grid transformer and associated cable works. The full cost of transmission works of £2.811m would be charged to SP Distribution under New Transmission Capacity Charges (NTCC), over a 40-year payback period starting in 2025/26 upon energisation of the new transformer.

The proposed replacement of GT3 transformer is shown in Figure 4.

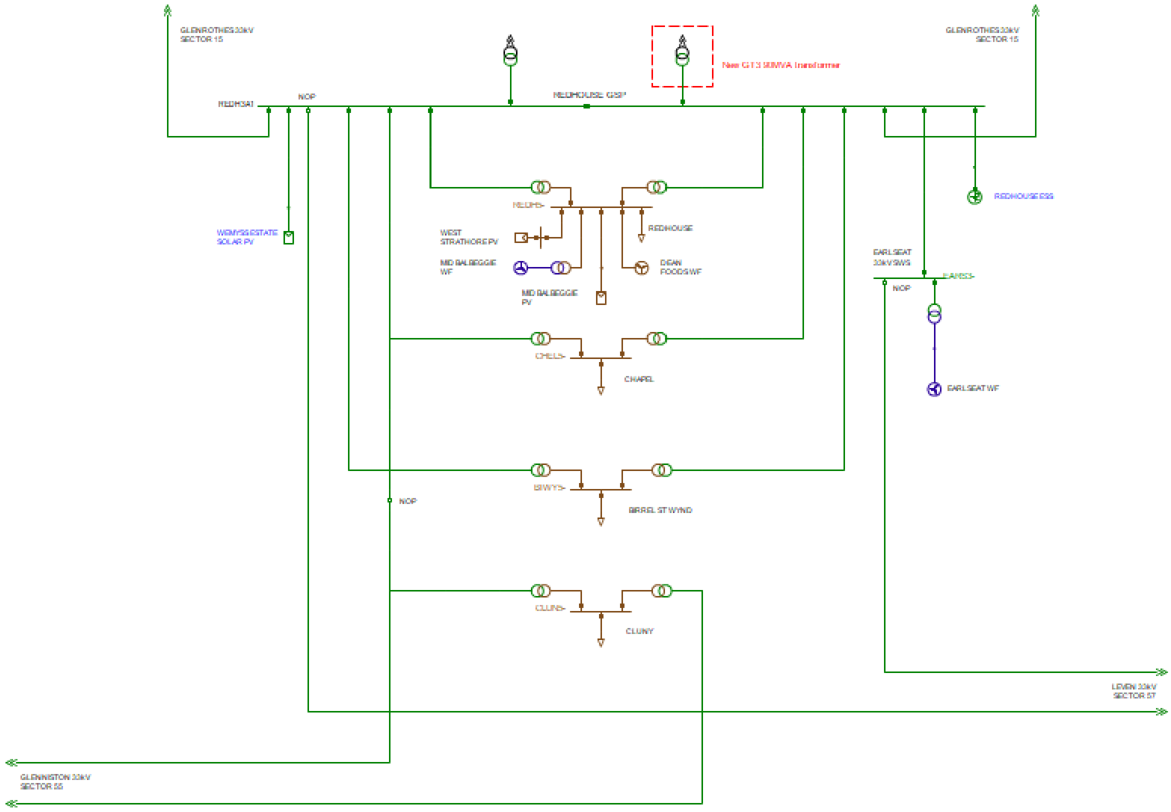

Figure 4. Schematic of the Baseline Option 33kV network

Table 5.4 shows a summary of reinforcement costs and volumes for Option 1 under RIIO-ED2.

Table 5.4. Baseline summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Post RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Other Costs CV1 (Identify Below)		0.038	0.038	-	-
Other Costs CV4 (Identify Below)		6.331	0.602	5.729	-
Total Costs		6.369	0.640	5.729	-
Identify activities included within other costs (please provide high-level detail of cost areas)					
CV1 – NGESO ModApp fee (£38k based on NGESO charges from 1st April 2021)					
CV4 – NTCC (New Transmission Capacity Charges) (£602k)					

5.3 Option 2 – Move demand into adjacent GSP

This option considers off-loading Pitteuchar primary to the adjacent Glenrothes GSP by relocating Normally Open Points (NOPs) to supply Pitteuchar primary from Glenrothes GSP. The Pitteuchar primary is currently supplied from Redhouse GSP via 33kV interconnectable circuits to Glenrothes GSP.

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

Table 5.5. Option 2 summary

Category	Scheme Name	Scheme Summary	Reporting Table	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Redhouse GSP Reinforcement	Move demand into adjacent GSP by relocation of NOPs and upgrade of 33kV circuits	CV1 Expenditure	3.226	-

By relocating NOPs to Redhouse GSP, both Warout Road primary and Pitteuchar primary would be supplied from Glenrothes GSP through the same 33kV circuits rated at 17.43MVA. However, as the total demand of Warout Road primary and Pitteuchar primary is forecasted to ca. 21MVA by 2028 under our Baseline View, the existing circuits feeding the group cannot provide sufficient thermal headroom to supply the full capacity of both demand groups. It is therefore proposed to provide a dedicated connection to Warout Road 33/11kV substation by installing two new 4.15km 33kV UGC circuits and associated comms infrastructure from the Glenrothes GSP. Two new 33kV circuit breakers will be installed at 33kV Glenrothes GSP switchboard.

The relocation of Pitteuchar primary would release ca. 10MVA from Redhouse GSP by the end of RIIO-ED2 with a peak demand of 51.4MVA. A peak demand at Glenrothes GSP with Pitteuchar primary will be 47.5MVA against the firm capacity of 120MVA.

Table 5.6 shows a summary of reinforcement costs and volumes for Option 2 under RIIO-ED2 and proposed 33kV network works for Option 2 is shown in Figure 5.

Table 5.6. Option 2 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non Pressurised)	8.3	1.657	1.657	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	2	0.334	0.334	-
Pilot Wire Underground	8.3	0.919	0.919	-
Civil Works at 33 kV & 66 kV Substations		0.024	0.024	-
Wayleaves/Easements/Land Purchase		0.028	0.028	-
Other Costs (Identify Below)		0.264	0.264	-
Total Costs		3.226	3.226	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£50k)				
Telecoms upgrade to modern intertripping (£60k)				
Normaly Open Points (£60k)				
Environmental consideration (£42k)				
Remote end protection (£42k)				
RTU/SCADA (£10k)				

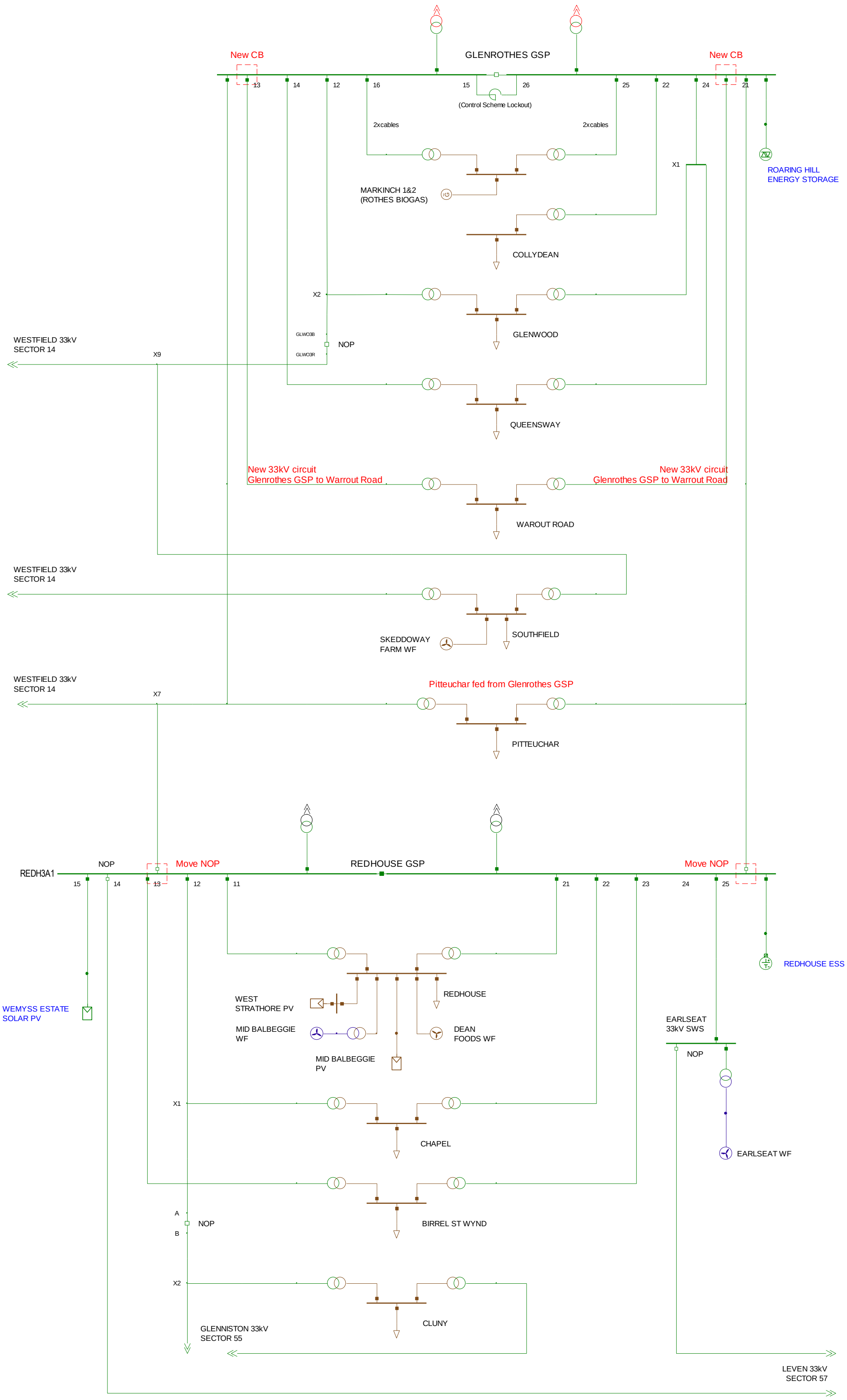

Figure 5. Schematic of Option 2 33kV network

5.4 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 60MVA grid transformer with a 90MVA unit	0.640
Option 1	Utilise flexibility services to defer reinforcement into RIIO-ED3	0.139*
Option 2	Move demand into adjacent GSP by relocation of NOPs and upgrade of 33kV circuits	3.226

*This option would defer a conventional reinforcement in terms of replacement of GT3 60MVA grid transformer to RIIO-ED3 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 Option 1, an innovative solution, to defer a conventional reinforcement to RIIO-ED3 by managing the thermal constraint through the RIIO-ED2 period by using flexibility services based on flexibility tender responses that have been received to date.

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-022-CV1-CBA – Redhouse GSP 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 60MVA grid transformer with a 90MVA unit	Rejected	Discounted based on NPV.				
Option 1 – Utilise flexibility services to defer reinforcement into RIIO-ED3	**Adopted**		0.16	0.27	0.31	0.29
Option 2 – Move demand into adjacent GSP by relocation of NOPs and upgrade of 33kV circuits	Rejected	Discounted based on NPV.	-1.30	-1.11	-0.72	-0.17

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 £0.139m 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)
Flexibility Services		0.139	0.139	-
Total Costs		0.139	0.139	-

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 Expenditure	**0.139**	0.005	0.008	0.010	0.030	0.087

6.4 Risks

There main risk is associated with any shortfalls in flexibility capacity. The overall risk to customers in this area is low as any flexibility capacity shortfalls would increase the heavy loading on the transformer but would not risk protection settings. In order to continue to mitigate this risk, we will continue to tender for flexibility services at 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 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 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	3,968		4,597	5,366	4,760	3,278	5,179	4,717	4,717
HPs	1,898		4,118	6,870	1,399	1,863	1,437	913	1,565

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

F – Utilise flexibility services
R1 – Replace 60MVA grid transformer (SP Transmission works)

The proposed solution is robust across a wide range of pathways. The timing of flexibility services is sensitive to uptake rates but is found to be required under all scenarios within the RIIO-ED2 period. The conventional reinforcement is required in RIIO-ED3 under all scenarios with different timings.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	Uncertain
RIIO-ED2 Expenditure (£m)	0.139	N/A
Comment	Proposed option	We will continue to tender for flexibility at this location to support management of this constraint in ED2. Replacement of the 60MVA grid transformer together with flexibility services is required in RIIO-ED3 under all scenarios.

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. 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. 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

Due to the nature of the proposed intervention, there will be no impact in relation to SPEN's Business Carbon Footprint (BCF).

6.7.2 Supply Chain Sustainability

Due to the nature of the proposed intervention, there will be no impact in relation to the sustainability of our supply chain.

6.7.3 Resource Use and Waste

Due to the nature of the proposed intervention, there will be no impact in relation to resource use and waste.

6.7.4 Biodiversity / Natural Capital

Due to the nature of the proposed intervention, there will be no impact in relation to biodiversity and natural capital.

6.7.5 Preventing Pollution

Due to the nature of the proposed intervention there will be no impact in relation to pollution.

6.7.6 Visual Amenity

Due to the nature of the proposed intervention, there will be no impact in relation to visual amenity.

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

6.7.7 Climate Change Resilience

Due to the nature of the proposed intervention, no impacts are anticipated in relation to future changes in climate.

7 Conclusion

To manage the thermal constraint on Redhouse grid transformer GT3 throughout RIIO-ED2, it is proposed it is proposed to defer a conventional reinforcement by managing the thermal constraint through the RIIO-ED2 period by using flexibility services based on flexibility tender responses that have been received to date. The proposed solution would defer a conventional reinforcement on the SP Transmission system of £2.811m which would include the replacement of the 60MVA grid transformer.

The proposed option is an innovative solution of procuring flexibility services from the market throughout the RIIO-ED2 period.

The estimated cost for the above is £0.139m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

The proposed solution represents the lowest cost and most efficient engineering solution from the whole system perspective to meet the forecast demand growth when compared with the alternative schemes identified.

8 Appendices

Appendix 1. System Study Results

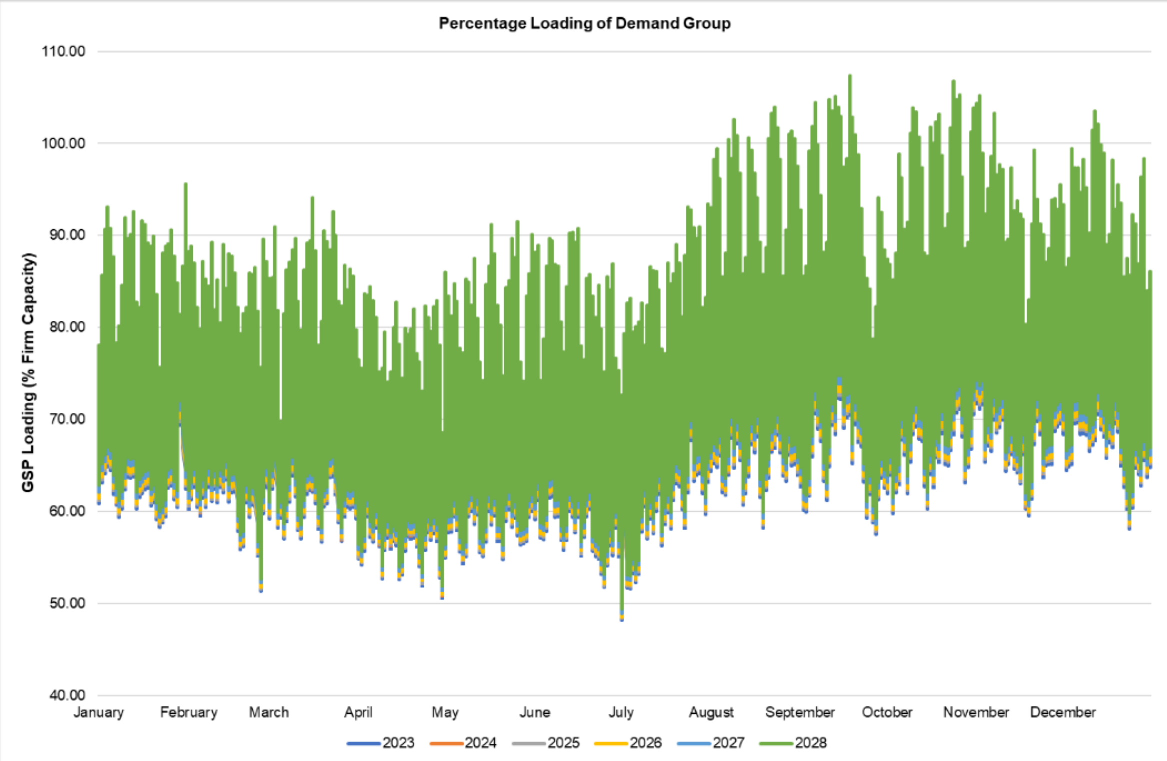

Figure 6. Half-hourly loading on 132/33kV 60MVA grid transformer

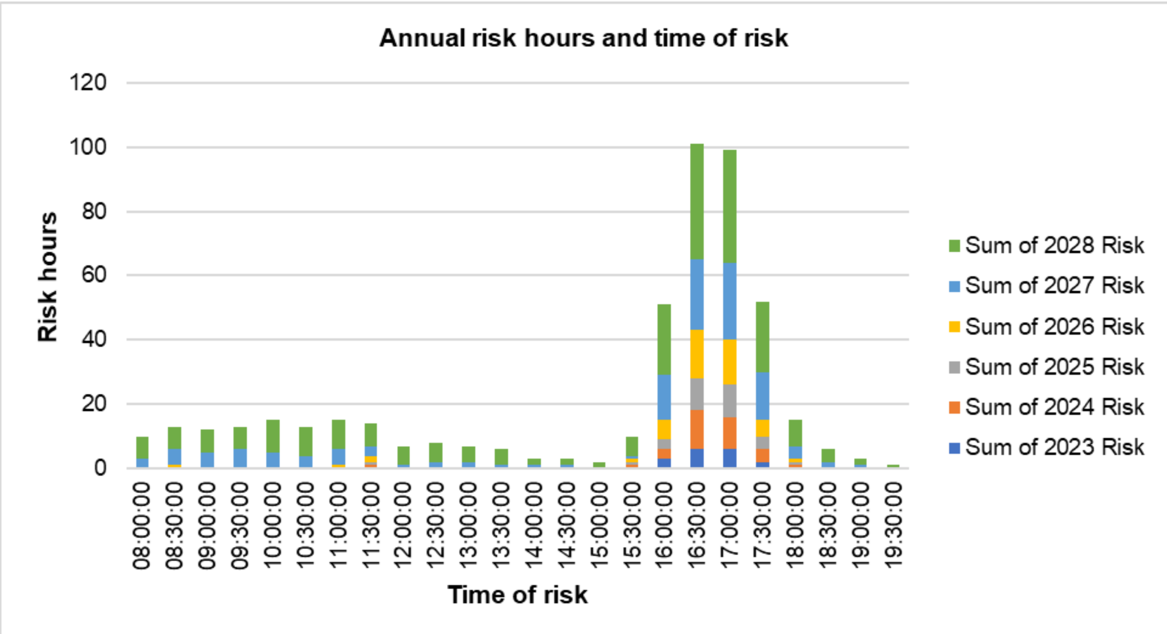

Figure 7. Calculated daily network risk hour window