PH004383

EJP/SHEPD/INVEE/BUMU/001-BURGHMUIR ENGINEERING JUSTIFICATION PAPER

Scottish & Southern Electricity Networks

CONTENTS

1 Executive Summary

1.1 Summary

This Engineering Justification Paper (EJP) outlines the proposal to reinforce the 33 kV network between Burghmuir GSP, and Inveralmond and Redgorton Primary Substations [redacted]

Within this paper, different options are considered to address the raised issues, while Ofgem-provided Cost Benefit Analysis (CBA) and Common Evaluation Methodology (CEM) were used to ensure that the most efficient and cost-effective solution is being progressed. The former determines the reinforcement option with the best Net Present Value (NPV) through the whole project life cycle, while the latter assesses whether flexibility employment would be viable and more economic compared to the baseline reinforcement.

Our proposed investment at Burghmuir GSP will resolve the thermal overload and deliver a compliant network up to at least 2050 [redacted]. The C0(a) and C0(b) costs of the considered options have been derived from the ED2 Ofgem Unit Cost Rates, with price base in 2020/21 and 2023/24, respectively. All costs given are C0(a), unless stated otherwise.

An overview of the considered options, the main drivers for the decision to progress or not to CBA, and the CBA results of the progressed options is provided in Table 1.1.

Table 1.1 Overview of Considered Options

Option	Description	CBA Consideration and Result
1. Do Nothing	No change to existing network topology	[redacted] - Not Progressed to CBA
2. Reinforcement of Existing Assets	Reinforce Burghmuir feeders (301) and (302) to Inveralmond and Redgorton Primaries.	[redacted] not feasible from an electrical point of view. - Not progressed to CBA
3. Combination of Reinforcing Existing Assets and Adding New Assets	Reinforce Burghmuir Feeders (301) and (302) to Inveralmond and Redgorton Primaries with the installation of two new 33kV switching stations.	[redacted] the land required is not available in the area. - Not progressed to CBA
4. Reinforcement by Adding New Assets and Network Reconfiguration	Install new cable circuits between Burghmuir and Inveralmond and a 7-panel 33kV switchboard. Reinforce 33kV network between Inveralmond and Redgorton Primaries.	[redacted]
5. Flexibility and Reinforcement	Flexible service contractor to reduce peak demand and defer capital investment. In this case, flexibility is assessed to defer the investment of option 4.	CEM suggests one year-deferral of investment. A flex viability assessment was conducted to ensure that there is enough flexibility in the area to accommodate the deferral. The reinforcement of option 4 can be deferred from 2026 to 2027 using flexibility services in 2026. - **Progressed to CBA and considered under CEM.** [redacted] **Preferred Option**

It has been decided to progress option 5 as this is the most cost-effective and efficient solution for this scheme, with its cost breakdown shown in Table 1.2. [redacted]

Table 1.2 Cost Breakdown of Option 5

Assets	Volume	Cost
33kV UG Cable (Non-Pressurised)	[redacted]	
33kV CB (Gas Insulated Busbars) (ID) (GM)		
33kV OHL (Pole Line) Conductor		
33kV Pole		
Flexibility in 2026		
Total Cost		

This investment to carry out the reinforcement works is being assigned to Large Capital Delivery (LCD) for design refinement and project delivery. It is proposed that the reinforcement works will start in 2024/2025, with flexibility acquirement in 2026, and delivery in 2026/2027.

This scheme delivers the following outputs and benefits:

- The uplift in network capacity of 23.6 MVA to meet the needs of our customers.
- Facilitates the efficient, economic, and co-ordinated development of our Distribution Network for Net Zero.

The proposed solution is designed to be strategic, so that there will be enough headroom to operate without congestions in the considered grid area until at least 2050.

2 Investment Summary Table

The table below provides a high level summary of the key information relevant to this EJP and the reinforcement of Burghmuir 33kV network.

Table 2.1 Definitions and Abbreviations

Name of Scheme/Programme	Burghmuir GSP Network Reinforcement
Primary Investment Driver	Load related – Thermal overload of Burghmuir feeders (301) and (302) Project Number: PH004383
Scheme reference/	EJP/SHEPD/IVEE/BUMU/001
Output reference/type	7.5km 33 kV UG Cable (Non-Pressurised) 7x 33 kV CB (Gas Insulated Busbars) (ID) (GM) 6.35km 33 kV OHL (Pole Line) Conductor 96 x 33 kV Poles Flexibility Services in 2026
Cost	[redacted]
Delivery Year	2026/27
Reporting Table(s)	CV1: Primary Reinforcement
Outputs in RIIO ED2 Business Plan?	Partially funded in RIIO-ED2 Plan. Funding covers up to

	£844,500 as per the previous EJP.	
Spend Apportionment	**ED2**	**ED3+**
	[redacted]	N/A
MVA released	23.6 MVA	N/A

3 Appendices Summary

Table 3.1: Appendices Summary

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Appendix A	Definitions and Abbreviations
Appendix B	Capacity Study Results
Appendix C	Network Plans
Appendix D	Sensitivity Analysis

4 Introduction

This paper outlines the need for reinforcement of the 33 kV network between Burghmuir GSP (245), and Inveralmond (240) and Redgorton (270) Primaries within the RIIO-ED2 period, [redacted]

Burghmuir GSP is located in the Perthshire area of Scotland which falls within the South Caledonia region of the SHEPD's licence area.

This paper presents options to rectify the projected conductor overload using flexible solutions and conventional reinforcement. Unlike the previous EJP, named Burghmuir 33kV Circuits and issued on 23rd of January 2020, this document identifies the issues within the ED2 price control period and presents solutions that ensure a constraint-free network operation up to 2050. As such, the previously proposed reinforcement was deemed inadequate and more suitable options were established.

Section 5 outlines the existing network arrangements, the load growth forecast based on the Distribution Future Energy Scenarios (DFES) data and network analysis, justifying the requirement of reinforcement. An overview and a comparison of the considered options are given in Section 6, with a detailed option analysis being provided in Section 7, where the reasons for the options that are deemed unviable, and thus not taken forward to the CBA, are presented. Details and the results of the CBA can be found in Section 8. The deliverability and possible risks of the proposed option are addressed in Section 9, while Section 10 presents the strategic planning of investment to operate a congestion-free grid up to at least 2050. Finally, Section 11 concludes this EJP, providing main conclusions and recommendations contained within this document.

5 Background Information

5.1 Existing Network Arrangements

Burghmuir GSP (245) is located in Perth and is supplied by two 90 MVA 132/33 kV transformers, GT1 and GT2, split across 3x section 1250 A 33 kV busbar and supplies about 24,148 customers via 7x 33 kV feeders and five primary substations, named Burghmuir (246), Inveralmond (240),Thimblerow (248), Goodlyburn (249), and Redgorton (270), as shown in Figure 5.1. The 33 kV Circuit Schematic Diagram of the current network is presented in Figure 5.2.

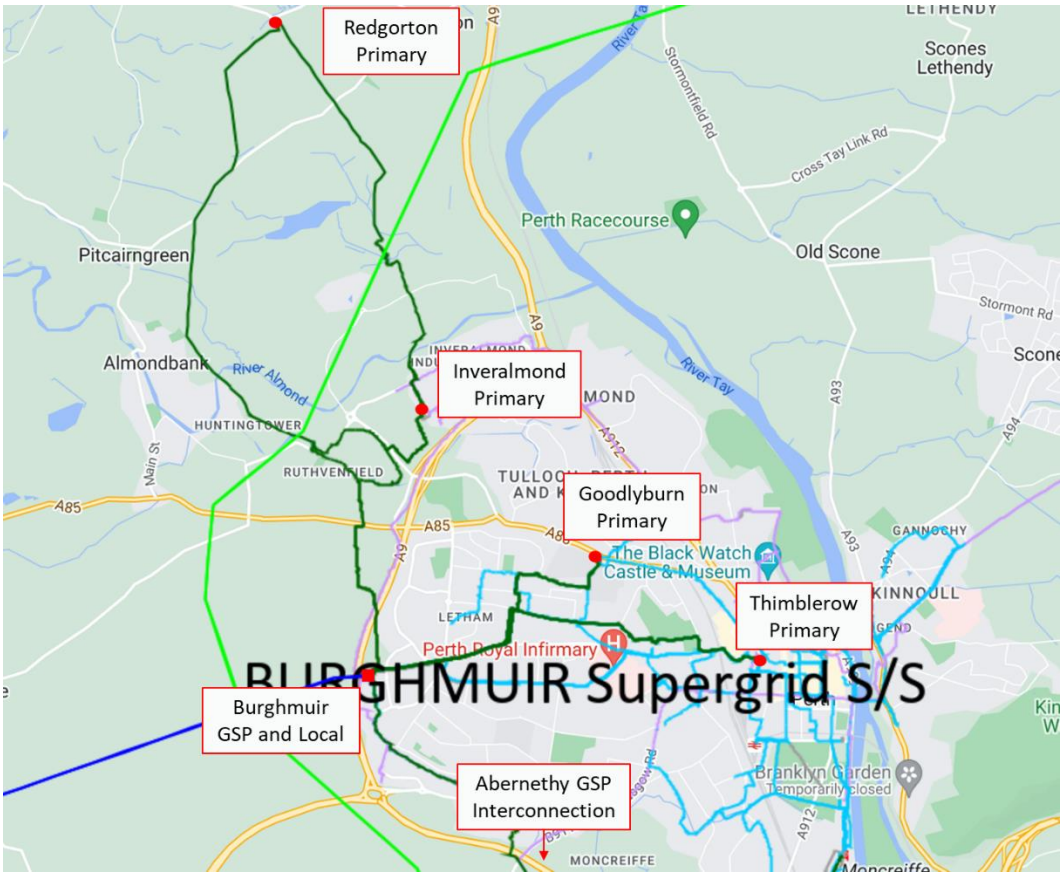


Figure 5.1 GIS Diagram of the Burghmuir 33 kV network.

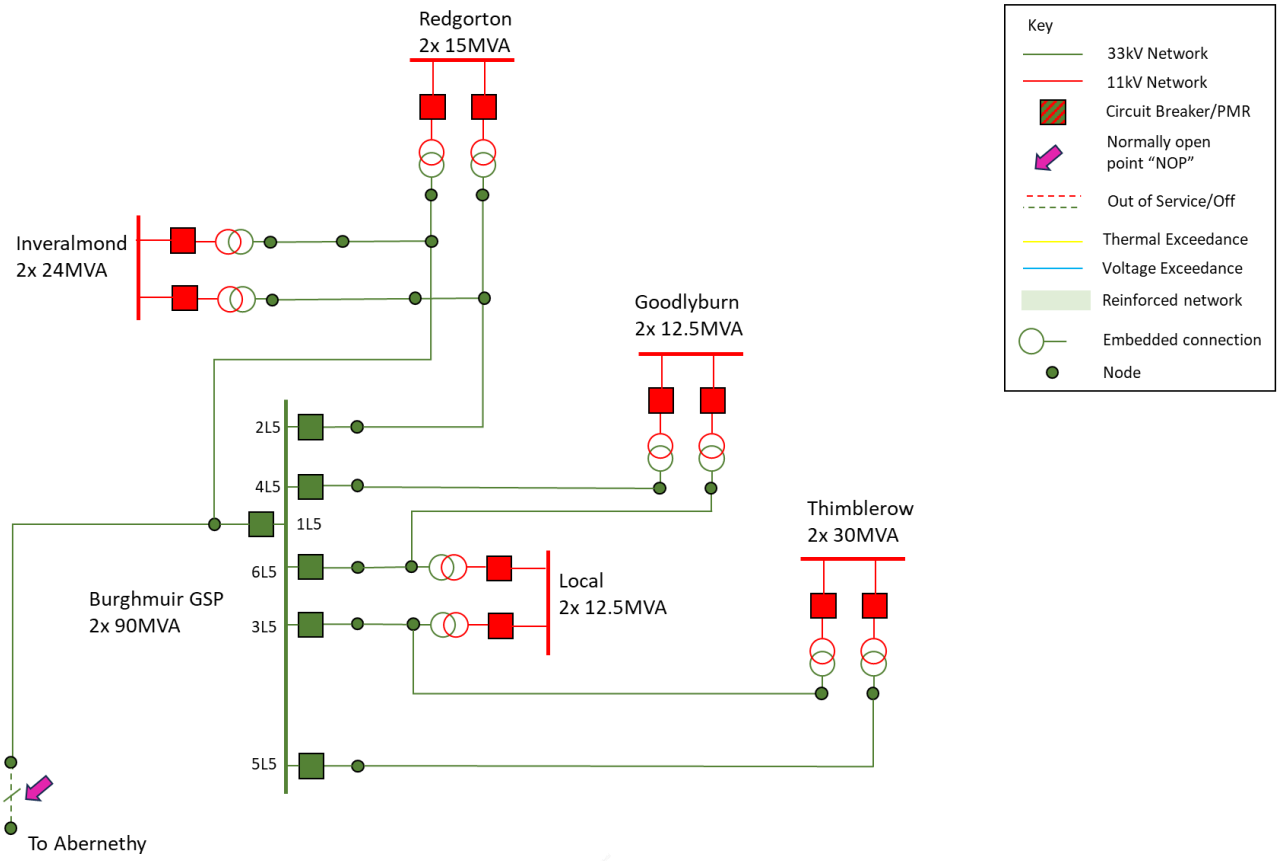


Figure 5.2 Burghmuir 33 kV Circuit Schematic Diagram

Inveralmond and Redgorton Primary Substations are equipped with two 12/24 MVA 33/11 kV and 7.5/15 MVA 33/11 kV transformers, respectively. Their 33 kV electrical arrangements are presented in Figure 5.3, along with the 33 kV arrangements of Burghmuir's GSP.

[redacted]

5.2 Load Forecast for Burghmuir GSP

The winter-peak demand forecast for each primary substation at Burghmuir GSP for the Customer Transformation (CT) decarbonisation scenario is illustrated in Figure 5.4. Only the winter-peak demand is presented in this paper, as this corresponds to the worst-case scenario. The CT forecast was used as baseline scenario for this study and proposal, since this is the most realistic between the very ambitious LW and the FS scenarios. It [redacted] These have been added to the DFES demand data of the respective substations to get a more accurate demand forecast, with the results being shown in Figure 5.5.

[redacted]

[redacted]

5.3 Existing Asset Conditions

[redacted]

[redacted]

5.4 Existing Operational Issues

No current operational issues have been identified.

5.5 Network Analysis Summary

Following completion of network analysis, the following constraints/conclusions have been identified in 2028:

5.6 Regional Stakeholder Engagement and Whole systems analysis Summary

Burghmuir GSP supplies the area governed by Perth and Kinross Council. Based on the DFES data, there are no known issues in the area under either normal or abnormal operating conditions.

As mentioned in Section 5.2, Bertha Park and Almond Valley are the two large, contracted connections being supplied by Inveralmond and Redgorton Primaries, respectively. The former is a sustainable development that was accepted in 2019 and thus, is well underway. It already includes a high school, a convenience store, a play park, and a wide range of housing. Once completed, it will consist of 3,000 homes, and commercial places to be used for shops, restaurants, and for medical, leisure, and community purposes. Almond Valley is a recently accepted residential-led development, which is expected to include up to 1,500 houses.

The area also includes four large generation points, with the largest reaching up to 2.75 MVA at Inveralmond. There is no information about Distributed Generation (DG) at Inveralmond Primary. The DG at Redgorton is predominantly hydro and solar and reaches a total of 1.37 MW, with the biggest registered capacity being at 0.95 MW.

SSEN has strong working relationships with local authorities and other key stakeholders in the region. We have met with Perth and Kinross Council to discuss local area energy planning, and the Council was a project partner in SSEN's Project RESOP trialling a software platform to support energy planning endeavours. We have also collaborated with the Council to install electric vehicle charging infrastructure at strategic locations along the A9 trunk road. SSEN engages with Scottish Government's LHEES Forum, Community Energy Scotland, and the Scottish Futures Trust. This

engagement has helped SSEN to stay informed about planning and development that will impact local communities' use of the network.

Net- Zero Strategy:

- Perth and Kinross Council aims to achieve Net – Zero carbon emissions by 2045 in alignment with Scottish Government targets and is rolling out a variety of projects and developments in pursuit of this.
- The Council has secured ECO Grants to support the provision of heat pumps to off gas and rural households across the local authority area through 2026. They also aim to have a fully developed electric vehicle network by 2030. Approved in mid-2022 and currently under construction, the Broxden – Low Carbon Transport Hub project will deploy electric vehicle charge points and co-located solar PV and battery at a strategic motorway location. Through 2030, Perth's Eco-Innovation Park will be rolling out low carbon housing, electrified transport, and a 20 MW solar park.

South Caledonia Local Housing Strategy:

- Perth's City Development Plan details the economic growth projected over the next twenty years and further infrastructure that will be required. The city of Perth's population is projected to increase 20% over the next two decades, requiring 5,000 new homes. This growth and infrastructure investment is supported by the Tay Cities Region Deal signed in 2020, which allocates hundreds of millions of pounds of funding from Scottish and UK Governments to cities including Perth.

5.7 Flexible Market Viability

To provide a cost-effective integration of new customers into the grid and to account for the expected load growth in the future, flexibility is used to defer or even avoid grid reinforcements.

Necessary for a postponement of the investment in assets is that the appropriate flexibility is available on the market. Therefore, the availability of flexibility to cover the expected demand that would otherwise exceed the network capacity was assessed for both Inveralmond and Redgorton Primaries.

The key assumptions used in the flex viability assessment are the following:

1. 90% of non-MD customers are domestic, giving a current estimate of 4,201 domestic households at Inveralmond and Redgorton in 2023. The number of households in the future is scaled according to government projections (increasing with time in Perth and Kinross).
2. 5.7% household participation rates in flex in 2023, up to 8.1% in 2026.
3. Average power reduction potential per household is 0.61 kW (based on results from ESO DFS). Growth of EVs and heat pumps has been identified using the DFES data for the CT scenario in each primary, and an assumption is made that 25% of future EV and heat pump connections participate in flex services.
4. Assumed 10% of all the MD customer's capacity would be available to be turned down for flex (this includes shops, hospitals, schools, etc.). Growth in commercial demand according to the DFES CT scenario has been accounted for in this figure.
5. A few generators were identified including several run-of-river hydro schemes and some PV. However, these were excluded due to inability to provide generation turn-up services. So, no generation was included in this analysis.

From the assumptions above and through extensive market and area research, the combined maximum capacity for flexibility for the two Primaries under consideration reaches about 1.6 MW in 2026, [redacted].

5.8 Confidence Table

Table 5.3 Confidence Table

Confidence Factor	Certainty (High, Medium, Low)	Comments
Load Forecast	High	Load forecast is in keeping with historical trend and accounts for contracted commercial background. All four DFES scenarios are within expectations and should accurately project the area's demand forecast.
Existing Asset Condition	High	The current asset conditions were provided by the Asset management database.
Existing Operational Issues	High	No current operational issues are known
Connections Activity	High	Load forecast is in keeping with historical trend and accounts for contracted commercial background.
Regional Stakeholder engagement	High	The local authorities have recently updated their commitment to achieve the zero net goals. They have set out goals and funding to reach these goals in the next years, which is incorporated in the forecast of the local DFES.
Flexible market Viability	Medium	The flexibility availability has been assessed for Inveralmond and Redgorton Primaries. [redacted] This would require us contracting with 67% of the identified potential flexibility and therefore the is a volume risk about being able to procure this flexibility. This calculation is conservation and can focused work in this area may allow us to successfully procure more flexibility. Early procurement may be needed to minimise network risk.
Funding Position	High	CT scenario shows overload before the end of ED2. Scheme partially funded as per the previous EJP.

6 Summary of options considered

6.1 Summary of Options

Table 6.1: Summary of Options

Option Considered	Description	Advantages	Disadvantages	Estimated costs (2023/2024)	CBA Consideration
1. Do Nothing	No change to the existing network tropology	No workload, no cost	[redacted]	[redacted]	Not progressed to CBA

			[redacted]		
2. Reinforcement of Existing Assets	Reinforce Burghmuir feeders (301) and (302) to Redgorton and Inveralmond Primaries.	[redacted] minimum cost	Not feasible from an electrical point of view	[redacted]	Not Progressed to CBA
3. Combination Of Reinforcement of Existing Assets and by Adding New Assets	Reinforce Burghmuir Feeders (301) and (302) to Redgorton and Inveralmond Primaries with the installation of two new 33kV switching stations.	[redacted] is electrically feasible.	It involves the installation of two new switching stations [redacted]	[redacted]	**Progressed to CBA**
4. Reinforcement by adding New Assets and Network Reconfiguration	Install new cable circuits between Burghmuir GSP and Inveralmond and a 7-panel 33kV switchboard. Reinforce 33kV network between Redgorton and Inveralmond.	[redacted] is electrically feasible. No land purchase is required.	It requires longer cables and a 7-panel switchboard that increase the budget.	[redacted]	**Progressed to CBA**
5. Flexible Solution or Curtailment **Preferred Option**	Use of flexibility In combination with Option 4	Defers the investment and leads to a reduced NPV, thus providing a benefit to the costs.	Flexibility does not increase network capacity permanently, so additional costs need to be covered for flexibility.	[redacted]	**Progressed to CBA and considered under CEM**

6.2 Options comparison table

The C0(a) costs of the considered options as per ED2 submission are listed below.

Table 6.2 Option Comparison

Option		CBA total Results (Whole life NPV)	C0(a) costs (£)			
			2024	2025	2026	2027
1	Do nothing	[redacted]				
2	Reinforcement of Existing Assets					
3	Combination of Reinforcing Existing Assets and Adding New Assets					
4	Reinforcement by Adding New Assets and Network Reconfiguration					
5	Flexibility and Reinforcement					

The C0(a) costs of the recommended option as per ED2 submission are listed below.

[redacted]

The C0(b) costs of the recommended as per ED2 submission adjusted for RPI to 23/24 Price Base

[redacted]

7 Detailed option analysis

7.1 Option 1: Do Nothing

[redacted] This is predominantly due to the load increase by generic growth in demand and two large load connections at the two Primaries.

Doing nothing in this case will have multiple implications such as:

- Equipment will be overloaded and therefore its life span will be shorter.
- Outages will occur causing economic and reputational loss.
- Security of supply will be endangered.
- New connections will not be able to connect to the grid.

[redacted]

Therefore, this option is not considered viable and has not been taken forward to the Ofgem CBA.

7.2 Option 2: Reinforcement of Existing Assets

This option requires the reinforcement of the feeders (301) and (302) from Burghmuir GSP to Inveralmond and Redgorton Primaries as shown in Figure 7.1. However, this solution presents issues form an electrical point of view. In the current configuration, the cable from Burghmuir GSP is laid up to the terminal pole where it changes to an overhead line. There is one short span of overhead line of approximately 8m in length which carries the full load of both Primary transformers. [redacted] For this reason, this solution is not acceptable.

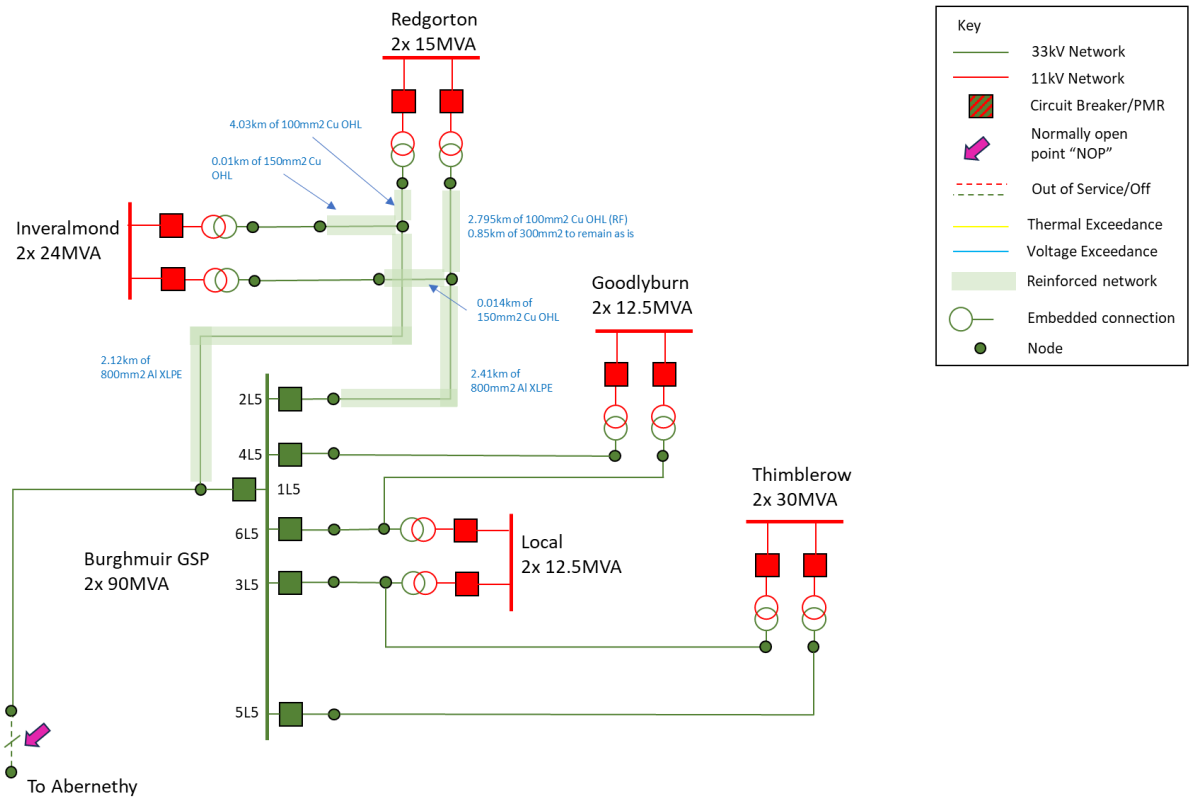


Figure 7.1 Option 2- Schematic of Proposed Solution

This option is not viable from an engineering point of view and has not been taken forward to the Ofgem CBA.

7.3 Option 3: Combination of Reinforcing Existing Assets and Adding New Assets

This option fixes the issue identified in Option 2. It requires the reinforcement of the feeders (301) and (302) from Burghmuir GSP to Inveralmond and Redgorton Primaries as in Option 2, but it also includes the installation of two 33 kV switching stations at the tee-off points. The schematic of the proposed reinforcement is presented in Figure 7.2, with the cable layout on the GIS Diagram being shown in Appendix C.

In addition, this option involves the purchase of land to install one of the switchboards, which will increase the budget. The other switching station can be installed at Inveralmond Primary. However, through the engagement with Investment Planning, OPS, and Design Teams, it was found that it is very difficult, if not impossible, to acquire land in the specified or nearby area. This is predominantly because most of the land belongs to IDNOs, and an adjacent high-pressure gas line adds further constraints.

The impact of the limited space is that acquired land is likely to be far away from the current primary; an alternative location will require longer cables, leading to higher costs. Furthermore, the procedures of search and acquirement of land requires time, prolonging the works, and considering the tight timeframe, this option will lead to additional implications in delivery.

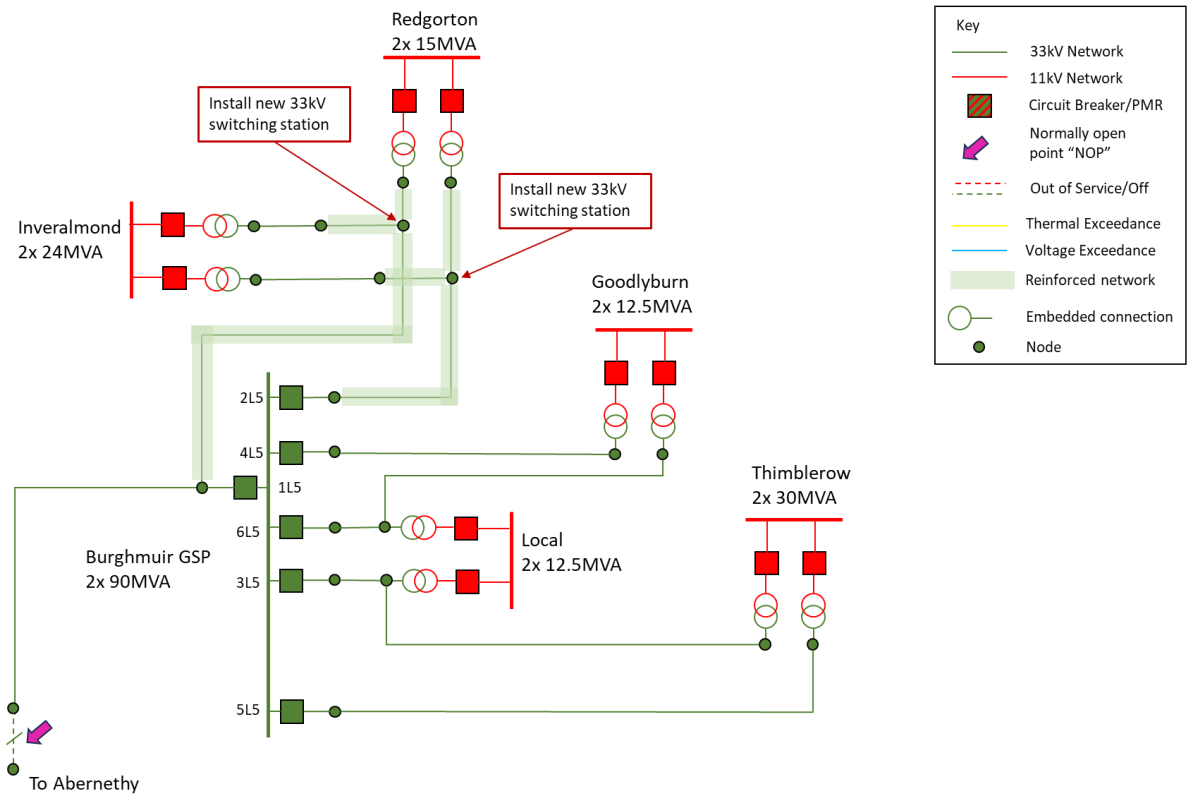


Figure 7.2 Option 3 - Schematic of Proposed Solution

Considering the very high risk of land unavailability and the other implications that are likely to arise, this option was discounted and has not been taken forward to the Ofgem CBA.

7.4 Option 4: Reinforcement of Existing Assets and Network Reconfiguration

This option requires the installation of new cable circuits between Burghmuir GSP and Inveralmond and of a seven-panel 33 kV switchboard at Inveralmond Primary. It also involves the reinforcement of the 33 kV network between Inveralmond and Redgorton Primaries. The schematic of the proposed solution and the cable routes can be seen in Figure 7.3 and Appendix C, respectively. This solution resolves the thermal issues with the installation of just one switching station at the Inveralmond substation. As such, no land acquirement is required, saving valuable time and resources, and increasing the confidence of an efficient development and an on-time delivery of the project.

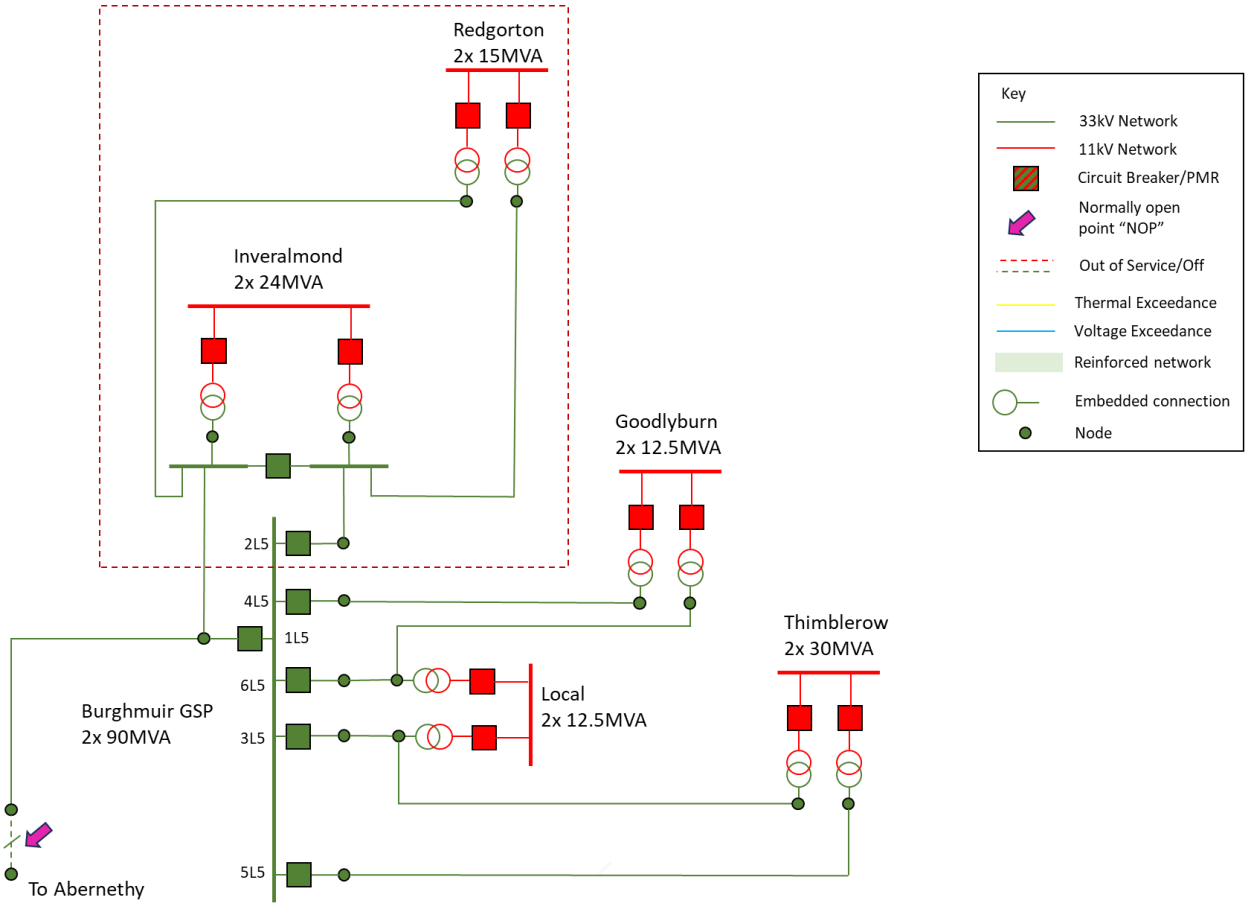


Figure 7.3 Option 4 - Schematic of Proposed Solution

The table below is a summary of estimated costs based on Ofgem ED2 Unit Rates.

Table 7.1 Option 4 Asset Unit Rates

Asset Description	Volume	C0(a) Cost	C0(b) Cost
33 kV UG Cable (Non-Pressurised)	[redacted]		
33 kV CB (Gas Insulated Busbars) (ID) (GM)			
33 kV OHL (Pole Line) Conductor			
33 kV Pole			
Total Cost			

This option resolves the raised issues, is electrically feasible and involves minimal risks. As such, it is progressed to the Ofgem CBA.

7.5 Option 5: Flexibility and Reinforcement

Option 4 offers the most efficient and the least risky reinforcement solution and thus, it was used as a baseline reinforcement scenario to assess whether the use of flexibility to defer intervention to the network is more economic. This option was progressed to CBA and considered under CEM.

Based on the assumptions in section 5.7, the flexibility and related services were studied for the CT scenario and a 12-year period, to determine whether flexibility would be an option to [redacted]

[redacted] The annual utilisation volumes provided by the internal DFES analysis tool are presented in Figure 7.4. Results correlate with the load data given in Section 5.2.

[redacted]

[redacted]

Flexibility is necessary to eliminate the exceedance and to ensure safe network operation. The calculated necessary flexibility in scope and time for the CT scenario is shown in Table 7.3.

[redacted]

The results from the CEM tool to determine the use of flexibility to defer the investment are shown in Figure 7.5. [redacted]

[redacted]

As shown, the tool recommends a one-year deferral in the CT scenario. [redacted] **According to the results above, any further deferral beyond 2027 will not add any benefits and will result in a worse NPV than option 4.**

The table below is a summary of estimated costs based on the Ofgem ED2 Unit Rates. The costs are identical to those of option 4 with the exception that this case includes flexibility in 2026.

Table 7.4 Option 5 Asset Unit Rates

Asset Description	Volume	C0(a) Cost	C0(b) Cost
33 kV UG Cable (Non-Pressurised)	[redacted]		
33 kV CB (Gas Insulated Busbars) (ID) (GM)			
33 kV OHL (Pole Line) Conductor			
33 kV Pole			
Flexibility			
Total Cost			

8 Cost Benefit Analysis (CBA)

8.1 CBA of investment options

Ofgem's RIIO-ED2 standard CBA template was used to assess costs and benefits. An overview of the options that are considered in the CBA are given in Table 8.1.

Table 8.1 Summary of Conventional Reinforcement Options progressed to CBA

Option	Year of Cost Activation	Total Costs (C0(a) - £m)	Risks
Option 4: Reinforcement of Existing Assets and Network Reconfiguration	2024-2026	[redacted]	
Option 5: Flexibility and Reinforcement	2025-2027		

8.2 CBA Results

A CBA has been conducted with a pre-specified discount rate of 3% as per the latest HMRC Green Book parameters, and a pre-tax WACC of 3.9%. The results on NPV are given in Table 8.2[redacted]

Table 8.2 NPV of Options

Options	CBA Results (NPV) in £m				
	10 years	20 years	30 years	45 years	Whole Life NPV
Option 4 - Reinforcement of Existing assets and Network Reconfiguration	[redacted]				
Option 5 – Flexibility and Reinforcement					

[redacted] Given the cost activation years between 2025 and 2027 for the investments, and discount and pre-tax WACC rates specified above, this results in a lower NPV than the baseline reinforcement - option 4. This is because the two options are identical but option 4 requires an earlier investment into assets. Specifically, Option 5 recommends a one-year deferral of reinforcement, which is viable as per the flex availability analysis presented in Section 5.7. As such, Option 5 is the preferred option.

9 Deliverability and Risk

The specific considerations for deliverability based on the scope of this EJP are detailed below:

- Low risk on the new 7-panel 33 kV switchboard – The proposed option involves the installation of a new 7-panel switching station at Inveralmond substation. As such, no further land acquirement is required, avoiding the risk of land unavailability.
- Medium risk on cable installation - The proposed new 33kV cable routes from Burghmuir to Inveralmond and Redgorton are relatively long (7.5km in total), but the route is partially set.
- Medium risk on flex availability – The availability of flexibility at both Redgorton and Inveralmond was assessed, [redacted] However, flexible services don not increase the network capacity permanently and there is the risk that they might not be in place to provide the flex required.

10 Outlook to 2050

Burghmuir is subject to mandated load scheduling under the DCUSA Schedule 8, Load Managed Areas (LMAs), regulations is currently delivered by the legacy Radio Tele Switching (RTS) system and its Smart meter-based successor.
The move to a Smart meter-based solution for providing LMA based diversity does not, on its own, provide a solution that is compatible with the development of domestic flexibility markets. Consequently, and in the spirit of a Smart and Fair transition, SSEN have committed to removing LMAs during ED2 and ED3.
Three methods used to remove LMAs include:

- Ensuring that any reinforcements driven by LCT growth are sized to ensure that they are not a driver for the continuation of an LMA.
- Improving network monitoring to allow the reduction of the scale of existing LMAs.
- Introducing a new market-based replacement for LMAs, this is expected to take the form of a diversity service.

The geographical area covered by this project is an LMA and as a result we have undertaken checks to ensure that the reinforcement will result in us being able to remove relevant LMA constraints.

Load managed domestic properties in the area account for approx. 13.7% of all customers.
The reinforcement is sufficiently large to allow the immediate removal of relevant LMAs and will remain unrestricted until we are able to offer a future market-based Diversity service or equivalent.

At this stage, the effect of RTS signal discontinuation on LMA areas is only a prediction and at each location may differ from what is stated in this report. Regardless, the options proposed in this paper should provide adequate solutions to any reasonable LMA-related increased demand.
It should be noted that the impact of LMA on the LV network has not been considered here and would require to be assessed separately.

The preferred solution provides additional headroom and more operational flexibility, ensuring a constraint-free operation until 2050. Loading on both lines is at 95% under N-1 operating conditions. However, it should be noted that the transformers at Redgorton Primary will be overloaded in 2050 but as per section 5.4, they will be in poor condition by 2035. As such, another study should look at their replacement in the future. The solved network model of the proposed solution in 2050 under N-1 conditions can be found in Appendix B.

11 Conclusion and Recommendation

This Engineering Justification Paper outlines the proposal to reinforce and reconfigure part of the 33kV network at Burghmuir GSP within the RIIO - ED2 price control period to address the projected thermal issues. [redacted] Option 5 was emerged to be the most promising, efficient, and cost-effective solution as per the Common Evaluation Methodology and Cost Benefit Analysis, and with the help of stakeholder engagement, whole system approach, and flexibility market analysis. The load-related investment has been triggered by load growth projected by DFES, for the CT scenario. To counter the thermal overload for abnormal network scenarios, Option 5 has been selected as preferred which utilises the available local flexibility and helps to delay the proposed reinforcement start date by one year. The summary of the proposed option can be found in Table 11.1.

Table 11.1 Summary of Recommended Option

Option	Advantage	Disadvantage	MVA release	Costs (C0(a) - £m)	Risks

Option 5 – Flexibility and Reinforcement	Most cost-effective And efficient option	The 7-panel switchboard adds to budget and maintenance costs	[redacted]

Table 11.2: Option 5 Asset Unit Rates

Asset Description	Volume	C0(a) Cost	C0(b) Cost
33 kV UG Cable (Non-Pressurised)	[redacted]		
33 kV CB (Gas Insulated Busbars) (ID) (GM)			
33 kV OHL (Pole Line) Conductor			
33 kV Pole			
Flexibility			
Total Cost			

This investment to carry out the reinforcement works is being assigned to the South Caledonia Region for design refinement and project delivery. It is proposed that the works will start in 2023/2024 with estimated delivery in 2025/26.

12 References

The documents detailed in Table 12.1 - Scottish and Southern Electricity Networks Documents, Table 12.2 – External Documents, and

, should be used in conjunction with this document.

Table 12.1 - Scottish and Southern Electricity Networks Documents

Reference	Title
TG-NET-NPL-007	Planning Standard for 33kV and 22kV Distribution Networks
TG-NET-NPL-010	Planning Standard for 11kV and 6.6kV Distribution Networks
TG-NET-SST-026	Ratings of Oil-Filled Power Transformers
Ofgem/SSEN CEM tool	ON22-WS1A-P1 CEM Tool V 2.2 SSEN

Table 12.2 – External Documents

Reference	Title
ENA EREC P2	Security of Supply
Ofgem CBA tool	RIIO-ED2_Cost Benefit Analysis_Template_0

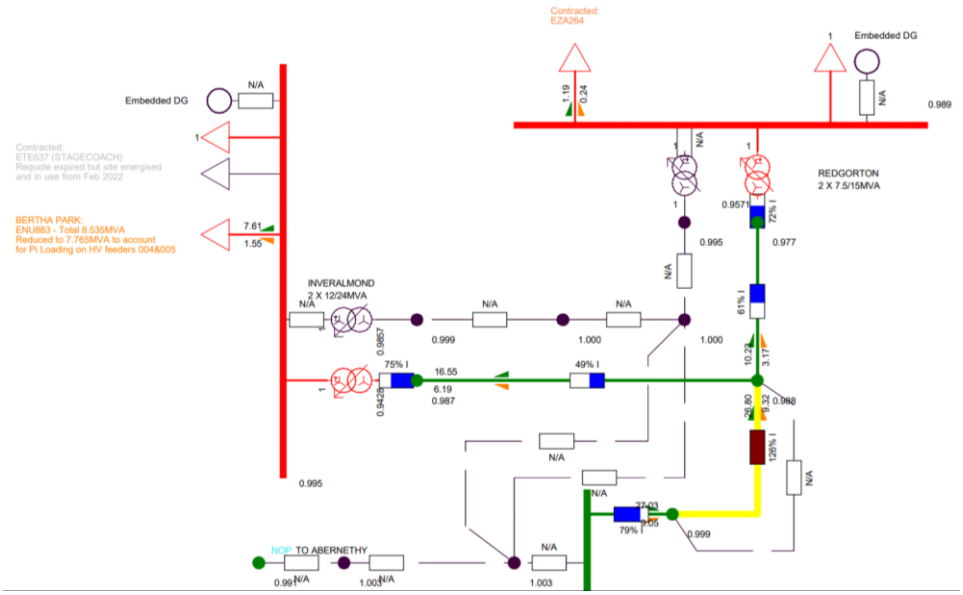
Appendix A Definitions and Abbreviations

Table 12.3 – Definitions and Abbreviations

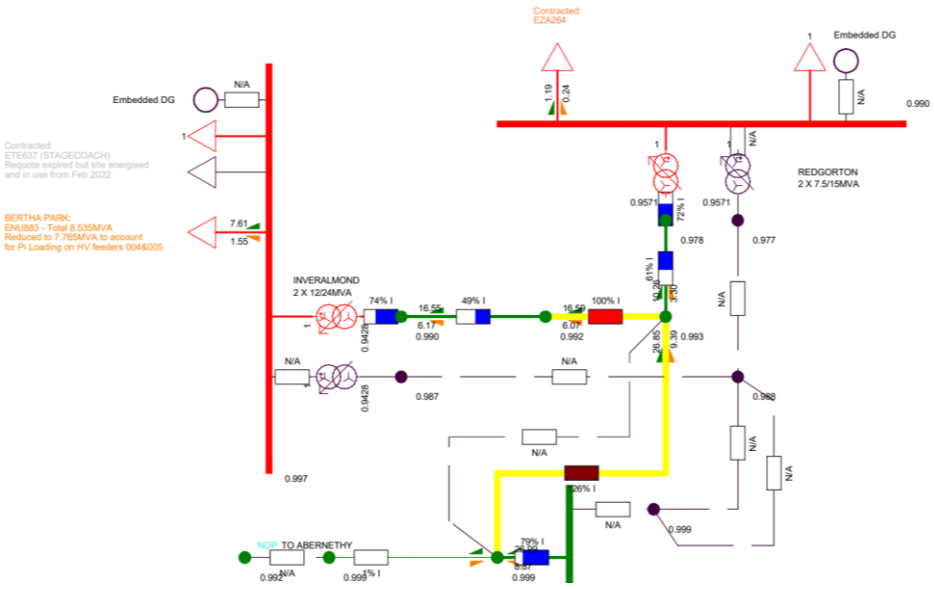
Acronym	Definition
AIS	Air-insulated Switchgear
ASCR	Aluminium Conductor Steel Reinforced
BSP	Bulk Supply Point
CBA	Cost Benefit Analysis
CBRM	Condition Based Risk Management
CEM	Common Evaluation Methodology
CI	Customer Interruptions
CML	Customer Minutes Lost
CT	Consumer Transformation
DFES	Distribution Future Energy Scenarios
DNO	Distribution Network Operator
EJP	Engineering Justification Paper
ESA	Electricity Supply Area
EV	Electric Vehicle
FCO	First Circuit Outage
FES	Future Energy Scenarios
GIS	Geographic Information System
GM	Ground Mounted
GSP	Grid Supply Point
HI	Health Index
IDP	Investment Decision Pack
LCT	Low Carbon Technology
LEP	Local Enterprise Partnership
LI	Load Index
LRE	Load Related Expenditure
LW	Leading the Way
NPV	Net Present Value
OHL	Overhead Line
PM	Pole Mounted
PV	Photovoltaics
RSN	Relevant Section of Network
SCO	Second Circuit Outage
SSEN	Scottish and Southern Electricity Network
SP	Steady Progression
ST	System Transformation
XLPE	Cross-linked Polyethylene

Appendix B Capacity Study Results

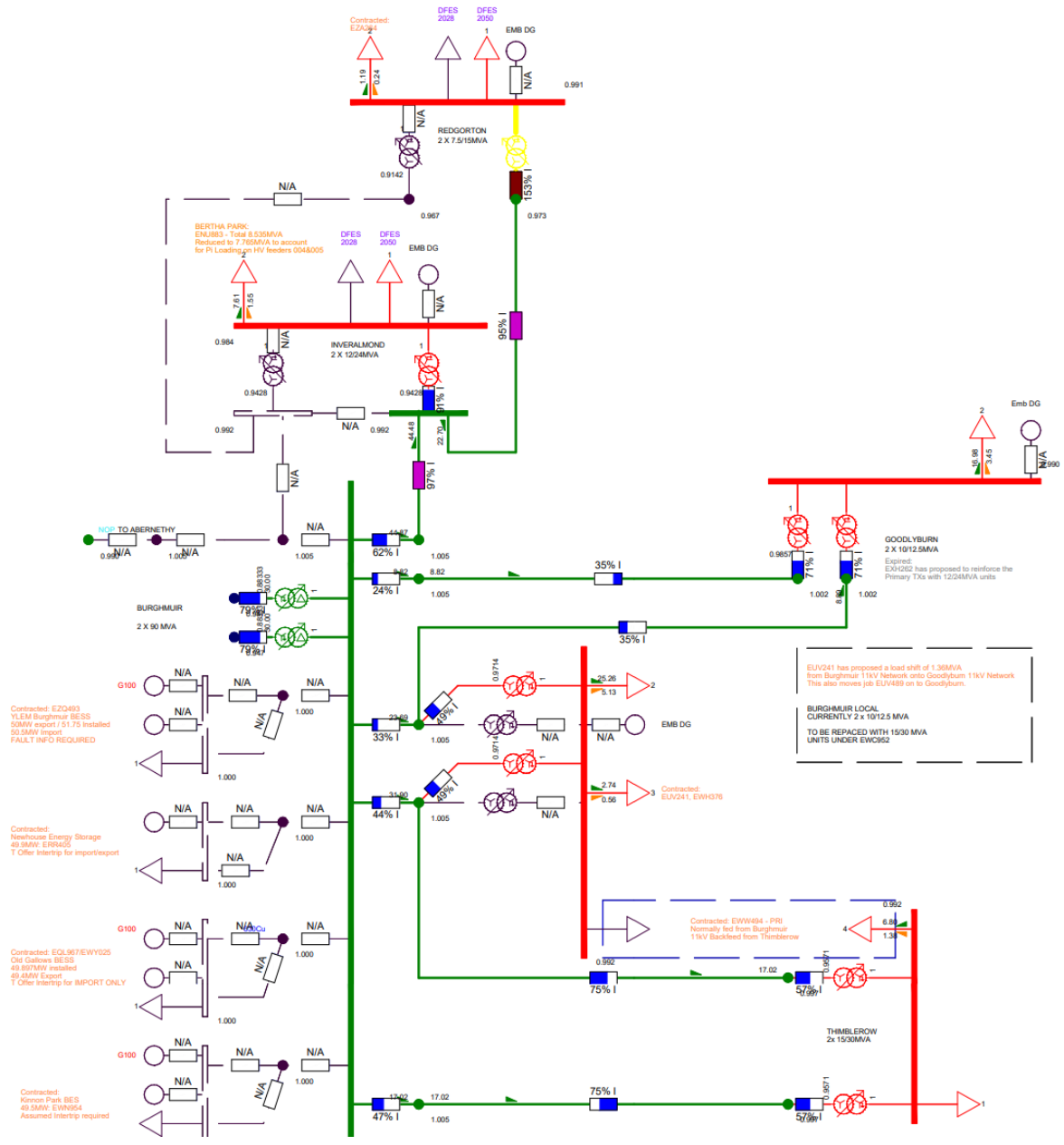
The current network circuit, solved for 2028 and under N-1 loss of Burghmuir feeder (301). As [redacted]



The current network circuit, solved for 2028 and under N-1 loss of Burghmuir feeder (302). As [redacted]

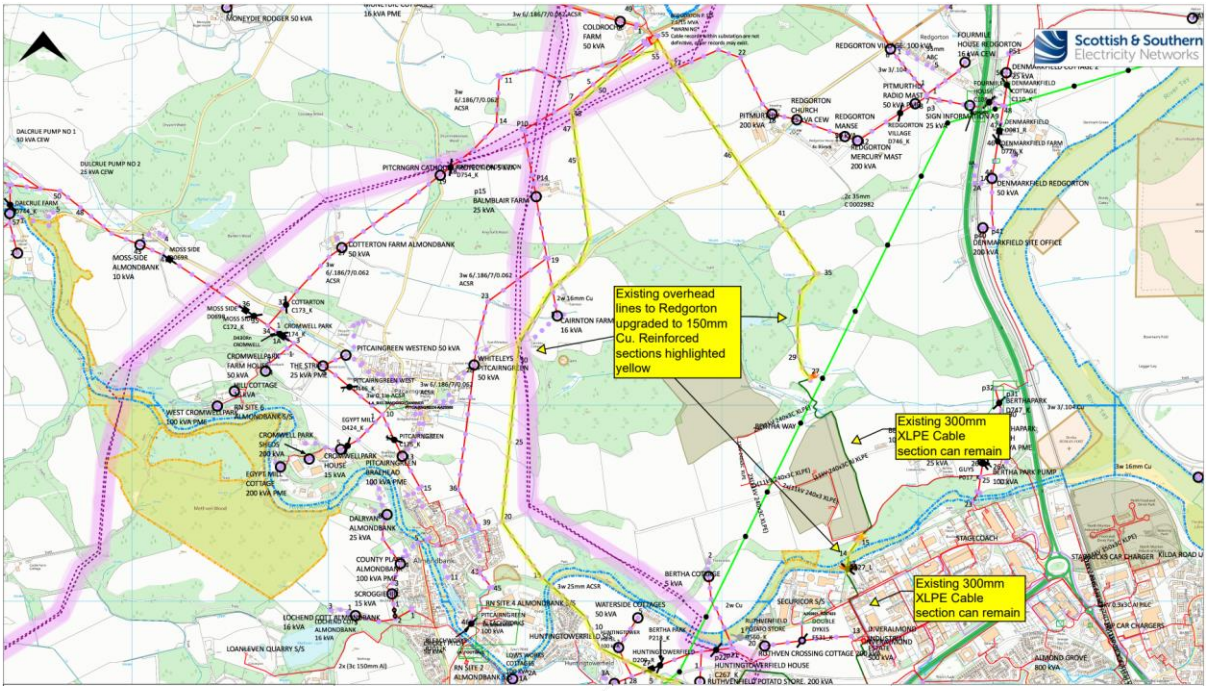


Reinforced network, solved for 2050 and under the worst scenario of N-1 operating condition. [redacted]

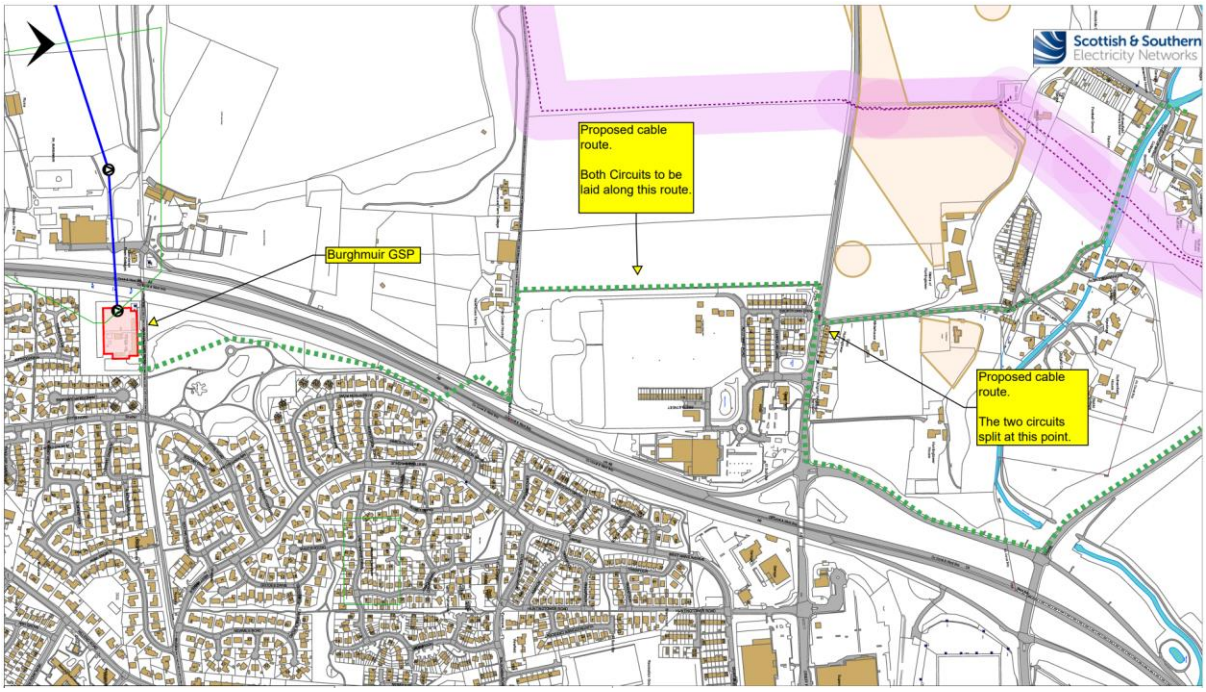


Appendix C Network Plans

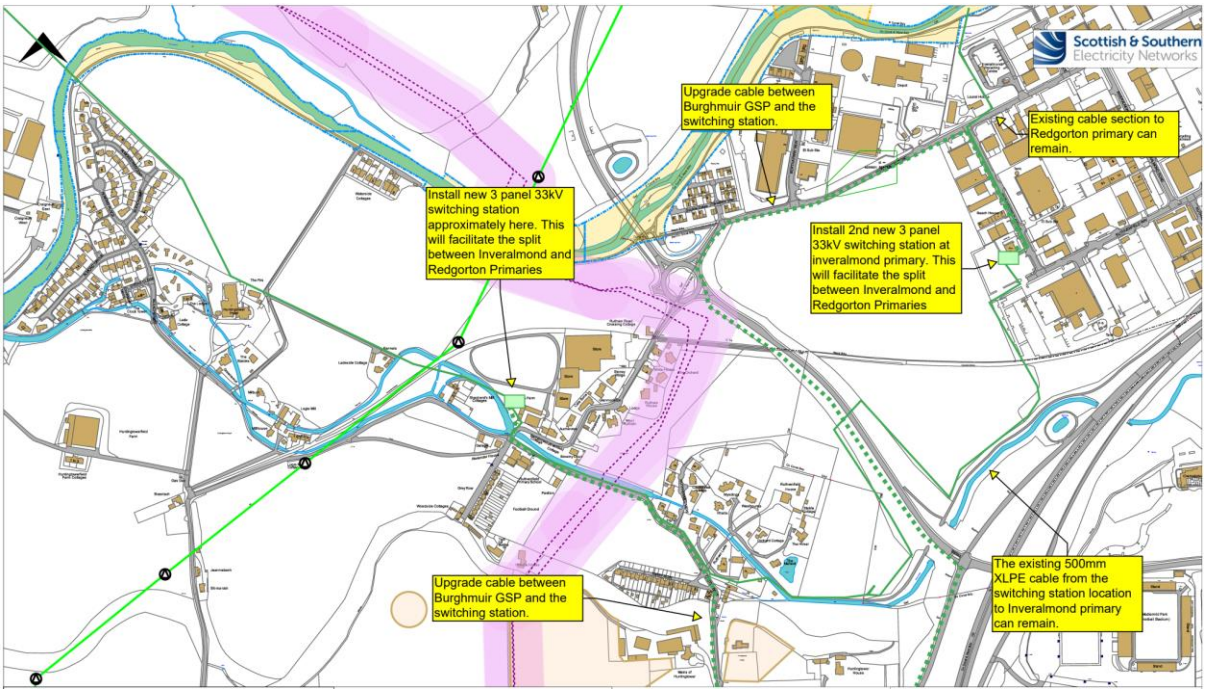
OHL Reinforcement for Options 3 and 4



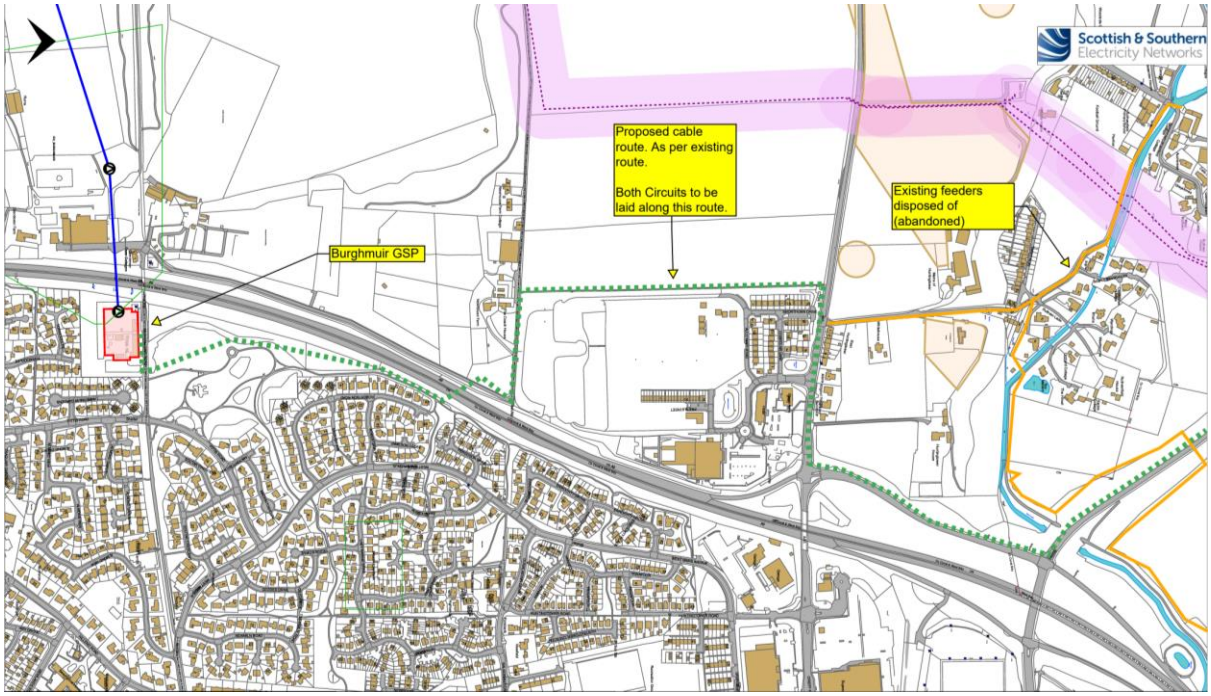
Option 3 – New Feeders



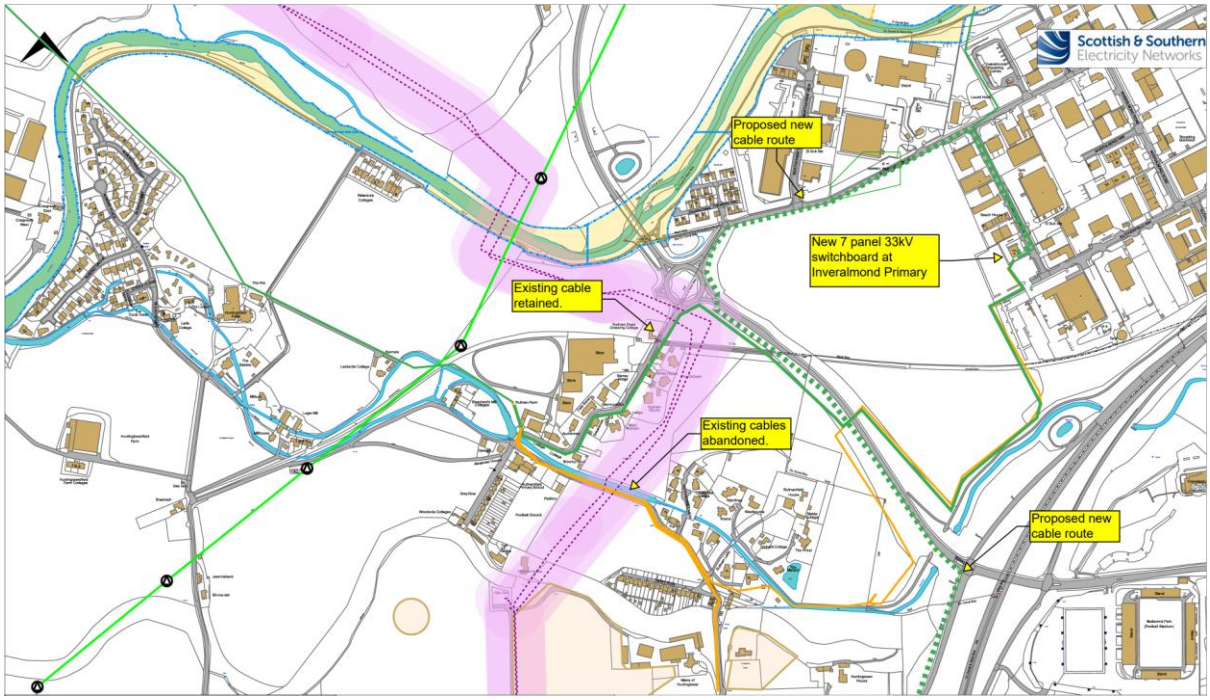
Option 3 – New Feeders - Plan 2



Option 4 – New feeders



Option 4 – New Feeders- Plan 2



Appendix D Sensitivity Analysis

For each investment proposed in this EJP, we have reviewed the annual max demand figures under all DFES scenarios out to 2050. Based on this assessment, we will place this investment into one of the categories [redacted]

Table 12.4

Category	Description	Applies to this EJP?
A	Schemes where the chosen investment size is large enough to meet peak demand/generation under all net zero compliant scenarios to 2050 or Schemes where the chosen investment size is large enough to meet peak demand/generation in ED2 and plans for further reinforcement are in place.	✓
B	Schemes where we would require further future reinforcement of the particular asset(s) being proposed under a more aggressive scenario to 2050	
C	Schemes where the proposed investment is not required under any scenario to	

	2050 (if any)	
D	Schemes where investment can be deferred until a later date under some scenarios i.e. ST scenario indicates no investment needed until 2030	

Justification for Categorisation:

[redacted]

The project falls into **category A**.

Flexibility will be procured in 2026 to cover the projected exceedance.

Once the reinforcement is complete in 2027, the investment will be large enough to meet the projected peak demand under all net-zero scenarios up to at least 2050.