Portobello Primary Fault Level Mitigation

ED2 Engineering Justification Paper

ED2-LRE-SPD-022-CV3-EJP

Issue	Date	Comments
Issue 0.1	Oct 2021	Issue to internal governance and external assurance
Issue 0.2	Nov 2021	Reflecting feedback from internal governance and external assurance
Issue 1.0	Dec 2021	Issue for inclusion in Final Business Plan submission

Scheme Name	Portobello Primary Fault Level Mitigation		
Activity	Fault Level Reinforcement		
Primary Investment Driver	Fault Level Mitigation		
Reference	ED2-LRE-SPD-022-CV3-PORTOBELLO		
Output	Fault Level Reinforcement		
Cost	£0.595m (in RIIO-ED2)		
Delivery Year	2026-2028		
Reporting Table	CV3		
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**
	£2.986m	**£0.595m**	**£0.0m**

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:	**Portobello Primary Fault Level Mitigation**
Project Reference:	**ED2-LRE-SPD-022-CV3**
Decision Required:	**To give concept approval for the replacement of the existing 11kV switchboards at Portobello Primary Substation.**

Summary of Business Need:

Portobello Primary Substation has been identified as above 11kV system design fault level limits and requires fault level reinforcement during the RIIO-ED2 price control. The peak make fault level at Portobello Primary Substation 11kV switchboard is significantly higher than the system design peak make limit. The rating of this legacy switchgear is considerably higher than the typical 11kV design limits. Under system intact conditions the peak make fault level is around 83.5% of the switchgear fault level rating, however this is around 119.8% of the system design fault level limit.

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 requirements and accommodate future growth and this proposal will meet that requirement.

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

It is proposed to install two new 33/11kV transformers and two new 11kV switchboards to replace the existing legacy rated 11kV switchboard. The T02 and T03 transformers will be retained and the T01 transformer will be disposed of. The 11kV switchboards will be replaced with two 11kV switchboards (Baileyfield Road "A" & Baileyfield Road "B") established at the existing substation site. In order to accommodate the additional transformer, the 33kV switchboard at Portobello GSP shall be extended and a new 33kV underground cable circuit installed to the primary substation. All associated project costs are included in CV3. The estimated cost for the above is £3.581m (in 2020/21 prices) with £0.595m to be included in the RIIO-ED2 load related expenditure.

Expenditure Forecast (in 2020/21)

Licence Area	Reporting Table	Description	RIIO-ED1 Total (£m)	RIIO-ED2 Total (£m)	Incidence (£m)				
					2023/24	2024/25	2025/26	2026/27	2027/28
SPD	CV3	Fault Level Reinforcement	**2.986**	**0.595**	-	-	0.119	0.238	0.238
SPD	**Total**		**2.986**	**0.595**	-	-	**0.119**	**0.238**	**0.238**

PART B – PROJECT SUBMISSION

Proposed by	Paul Dynes	Signature	Date: 30/11/2021
Endorsed by	David Neilson	Signature	Date: 30/11/2021

PART C – PROJECT APPROVAL

Approved by	Malcolm Bebbington	Signature	Date: 30/11/2021

Contents

1 Introduction

Portobello Primary Substation is located in the Edinburgh & Borders district of SP Distribution (SPD), providing supplies to ca. 22,310 customers.

Fault levels at Portobello Primary Substation 11kV switchboard are in excess of the system design maximum fault level (250MVA). Under design policy, the fault level mitigation is deemed necessary above 95% threshold.

This scheme is a RIIO-ED1 carryover scheme and a part of a wider strategy on reinforcement and rationalisation of the East Edinburgh 33kV and 11kV network. There are 3 work packages spaced across RIIO-ED1 and RIIO-ED2.

In order to comply with section 9 of the Electricity Act and Condition 21 of our licence obligation "to develop, maintain an efficient, coordinated and economical system for the distribution of electricity", and enable future connections, it is proposed to replace the existing legacy rated 11kV switchboard at Portobello Primary Substation with two new 11kV boards, replace one of the three existing 33/11kV transformers and install one additional 33/11kV transformer to resolve. The SP Distribution works for this solution involves the installation of 29 x 11kV distribution panels, 2 x 33/11kV transformers, 1 x 33kV distribution panel and associated environmental, engineering, civils and 33kV cable installation between the GSP and primaries.

14 x 11kV distribution circuit breakers, 2 x 33/11kV transformers and 1 x 33kV distribution circuit breakers have already been bought in RIIO-ED1 with a spend of £2.986m. The estimated cost for the rest of the works to complete the board replacement is £0.595m under CV3 expenditure with 100% contribution to be included in the RIIO-ED2 load related expenditure.

In order to resolve the fault level issues and enable future connections, it is proposed to continue the works and the fault level scheme output will be claimed in 2027/28 at the end of the project. The proposed option provides an additional 104MVA (peak make)/81MVA (RMS break) fault level headroom, on equipment rating; and 249MVA (peak make)/153MVA (RMS break), on design rating.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Portobello primary demand group. The existing site has ample space to support the proposed development within the existing substation footprint. The geographical layout of the site is depicted in Figure 1.

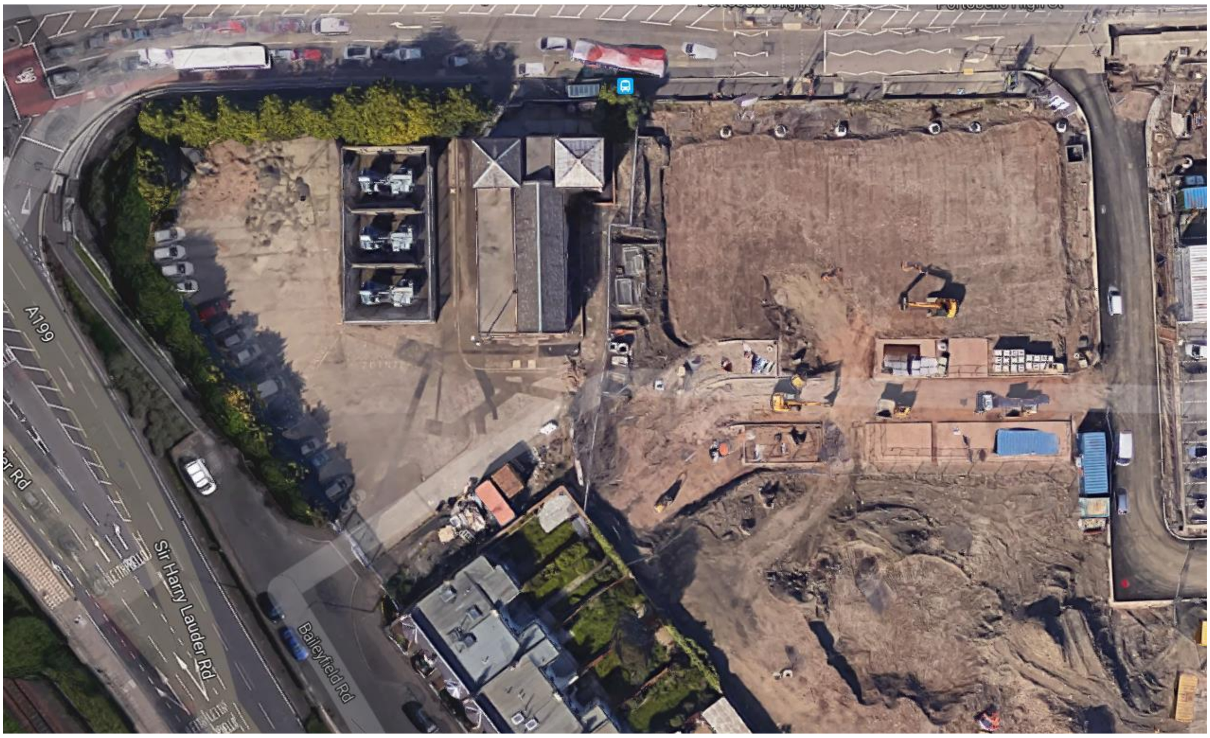

Figure 1. Portobello primary site geographical layout

The existing 11kV network comprises of underground cable. Portobello primary is interconnected at 11kV with Lower London Rd, Lochend Quadrant, Bonnington Road, Niddrie, Little France, Easter Road and Park Road primary substations.

The 11kV switchboard consists of 33 panels, 24 of which are feeder breakers, three bus sections and six incomer breakers.

Portobello primary substation is served by three 12/24MVA, NI Transformers 33/11kV transformers (1991) which will have health index 3 by the end of RIIO-ED2. The 11kV group is fed from Portobello Grid Supply Point (GSP), via the 33kV network shown in Figure 2.

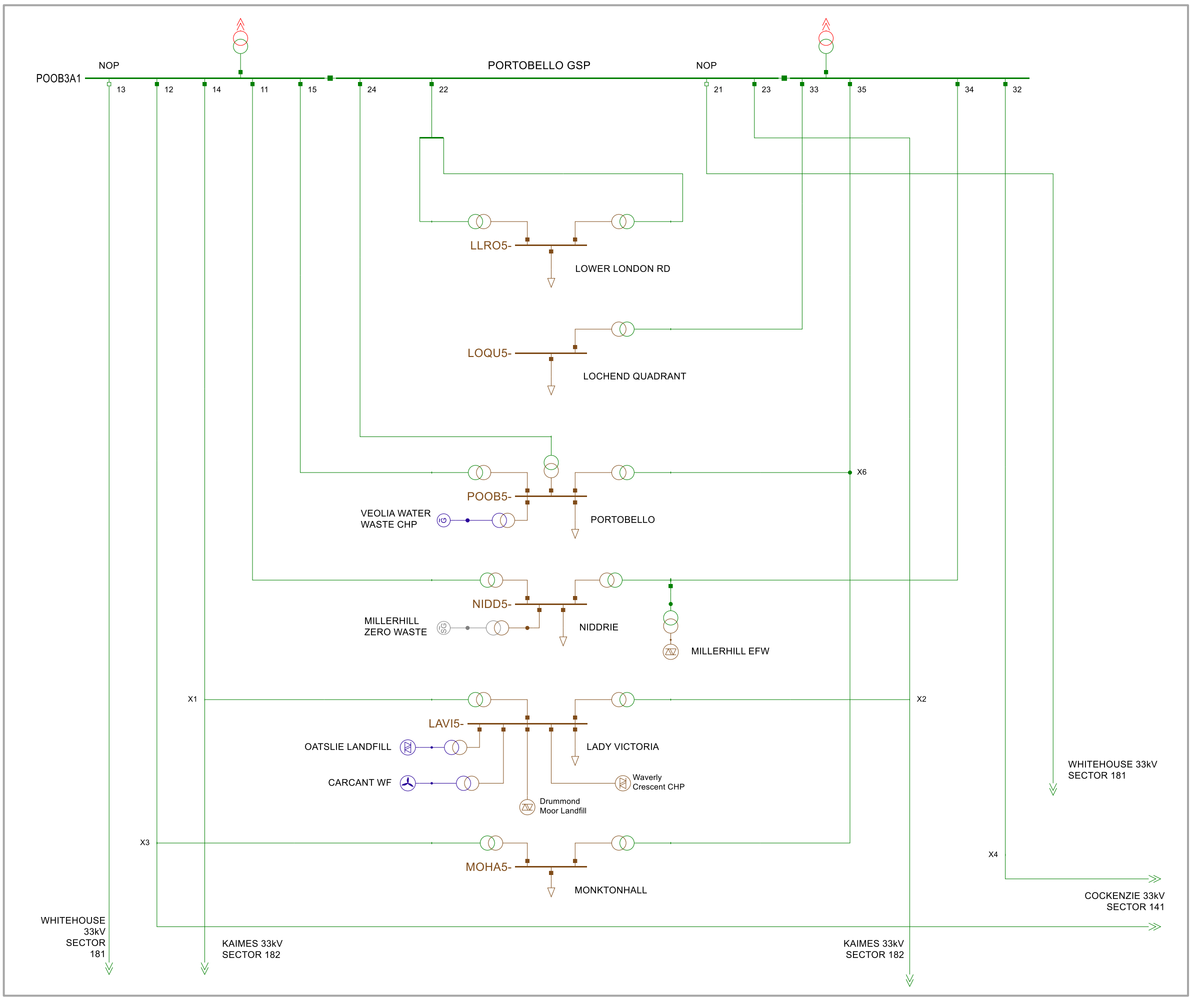

Figure 2. Existing Portobello primary 33kV network

2.2 Network Supply / Circuit Capacity

The existing Portobello Primary peak demand is around 28.8MW which is a class 'C' of supply as per ENA Engineering Recommendation (EREC) P2/7. The 33kV connection circuits extend from Portobello GSP and each 33kV circuit is constructed of 240mm^2 Al cables.

2.3 Embedded Generation

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

Table 2.1. Embedded generation connected to Portobello primary

Primary	Voltage (kV)	Site	Capacity (MW)	Type	Status
Portobello	11	Seafield Sewage Plant	3.19	Waste Incineration (Not CHP) (>=1MW)	Connected

2.4 Fault Levels / Design Limits

Switchgear is required to have the capability of "making" fault current i.e. closing onto an existing fault and "breaking" fault current i.e. opening and so disconnecting a fault from the system, these duties are defined in terms of Peak Make and RMS Break.

Typical planning limits for fault level duties on the SPD network are shown in Table 2.2. These are the design limits for the 11kV network.

Table 2.2. Fault level design limits

System Voltage (kV)	3-phase Fault Level Limits (kA)		1-phase Fault Level Limits (kA)	
	Peak Make	RMS Break	Peak Make	RMS Break
HV	32.80	13.12	32.80	13.12

The switchgear fault level duty assessments are based on the SP Energy Networks (SPEN) design policies ESDD-02-006[1], under which the design principles effectively ensure with regards to the equipment duty, the prospective network fault levels shall never be more than 100% of the plant capability. However, to reflect the potential for under-estimation due to generic assumptions and modelling errors, sites exceeding 95% of design rating are considered for mitigation.

Table 2.3 shows the current 11kV 3-phase and 1-phase fault levels as a percentage of the lowest of switchgear ratings / design limits at the Portobello primary substation.

Table 2.3.Portobello primary fault level (LTDS 2020)

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
Portobello primary	32.80	13.12	38.66	13.03	39.3	14.45	**119.82**	**110.14**

[1] ESDD-02-006 – Calculation of System Fault Levels

3 Needs Case

Switchgear are network assets which keep the higher voltage network safe in the event of a fault. They safely isolate the faulted section of the network. Switchgear is rated to safely operate with a certain level of fault current. Fault level constraints limit the safe operation of this group.

Both the 11kV peak make and RMS break duty fault level exceed the design rating and are around 120% and 110% respectively. The main reason for the high fault level is due to the legacy connection arrangement of the primary substation including three transformers and three busbar sections. The 11kV primary switchgear is rated at 350MVA however the network switchgear on the connected circuits will be rated at 250MVA which puts the wider 11kV network at risk. It is therefore necessary to mitigate the existing fault levels, to continue to maintain a safe and secure network.

3.1 Forecast Demand

The system is forecast to grow 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.

DFES includes granular forecasts to 2050 for demand, generation and Low Carbon Technologies. They assess credible future scenarios covering a range of uncertainties, including differing levels of consumer ambition, policy support, economic growth and technology development and the forecasts are underpinned by extensive stakeholder engagement.

The peak demand forecast based on the SPD Distribution Future Energy Scenarios is 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.

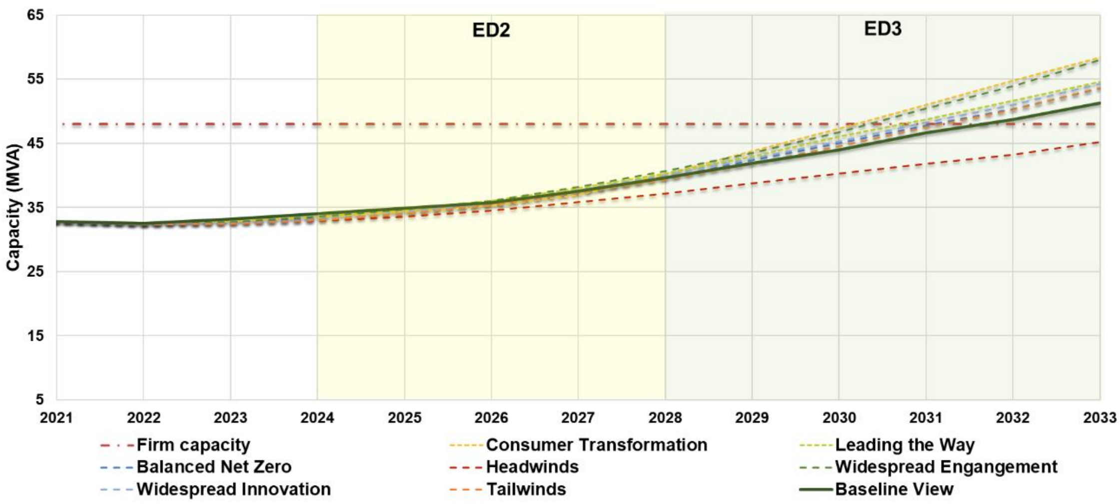

Figure 3. Demand (MVA) forecast for Portobello primary demand group

3.2 Forecast Generation

There is less than 1MW generation forecasted to be connected to Portobello primary based on Distribution Future Energy Scenarios.

3.3 Network Impact Assessment

The Portobello primary group have been assessed with the forecast demand growth, covering thermal and fault level constraints while considering the different demand forecast scenarios.

3.3.1 Thermal Constraints

No additional thermal constraints have been identified in the group under intact and outage conditions with the forecast demand growth.

3.3.2 Fault Level Constraints

The fault level issues at Portobello primary will persist and continue into RIIO-ED2, likely exacerbate with the connection of new load and generation and require operational measures to manage the fault level exceedances.

Table 3.1 shows the 33kV 3-phase fault levels as a percentage of the switchgear ratings at the Portobello primary substation by the end of RIIO-ED2, which includes DFES generation and demand forecasts.

Table 3.1. Portobello primary fault level (2028)

Substation Name	Switchgear Rating (kA)		3-phase Fault Levels (kA)		Duty (%)	
	Make	Break	Make	Break	Make	Break
Portobello primary	33.46	13.12	32.21	11.51	**96.26**	**87.73**

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	Rejected as it does not address the network fault level issues.
(b)	Intervention plan using only Energy Efficiency	Rejected	Rejected as it does not address the network fault level issues.
(c)	Replace 11kV switchboard and establish 'B' substation	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	Replace 11kV switchboard and primary transformers	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Install Active Fault Level Management AFLM) with Real-Time Fault Level Monitoring (RTFLM) scheme.	Rejected	Rejected as it would not be expected to endure due to the significantly lower capability of the legacy switchgear. Also, considering the age of the 11kV switchboards, this option would not be expected to be an enduring solution.
(f)	Install an 11kV bus section reactor	Rejected	Rejected due to Transient Recovery Voltages (TRV) when switching the bus section reactor in/out. Upgrading the 11kV primary switchboard would not fully mitigate the issue as current chopping would cause voltage spikes which could damage downstream SPEN and customer equipment.
(g)	Install 11kV series reactors in the tails of the primary transformers	Rejected	Rejected due to Transient Recovery Voltages (TRV) when switching the bus section reactor in/out. Upgrading the 11kV primary switchboard would not fully mitigate the issue as current chopping would cause voltage spikes which could damage downstream SPEN and customer equipment.

5 Detailed Analysis & Costs

5.1 Proposed Option (Baseline) – Replace 11kV Switchboard & establish 'B' substation

The proposed solution is to replace the existing 11kV switchboard and establish Baileyfield Road 'B' primary substation with two 12/24MVA 33/11kV transformers and a 15-panel 11kV switchboard, located in a housing. The existing Portobello T02 and T03 transformers will be used to feed the new Baileyfield Road 'A' Primary. Baileyfield Road 'B' primary will be connected at 33kV to the Portobello GSP 33kV busbar via an extension to the existing 33kV busbar. Table 5.1 shows the scheme summary.

Table 5.1. Baseline option summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Portobello Primary Fault Level Mitigation	Establish Baileyfield Road 'B' primary and replace existing 11kV switchboard	0.595	-

This solution creates additional fault level headroom at Baileyfield Road 'A' and Baileyfield Road 'B' primary substations as shown in Table 5.2.

Table 5.2. Baseline option fault levels at Baileyfield Road 'A' and Baileyfield Road 'B' primary substations

Substation Name	Design Rating (kA)		3-phase Fault Levels (kA)		Max 3-phase Duty (%)	
	Make	Break	Make	Break	Make	Break
Baileyfield Road 'B' primary	32.80	13.12	27.93	8.69	**75.21**	**66.34**
Baileyfield Road 'A' primary	32.80	13.12	24.67	9.38	**85.15**	**71.60**

Baileyfield Road 'B' primary will be located within the existing Portobello Primary Substation compound, highlighted in red in Figure 4. The proposed 33kV network is shown in Figure 5.

Figure 4. Baileyfield Road 'B' primary proposed location

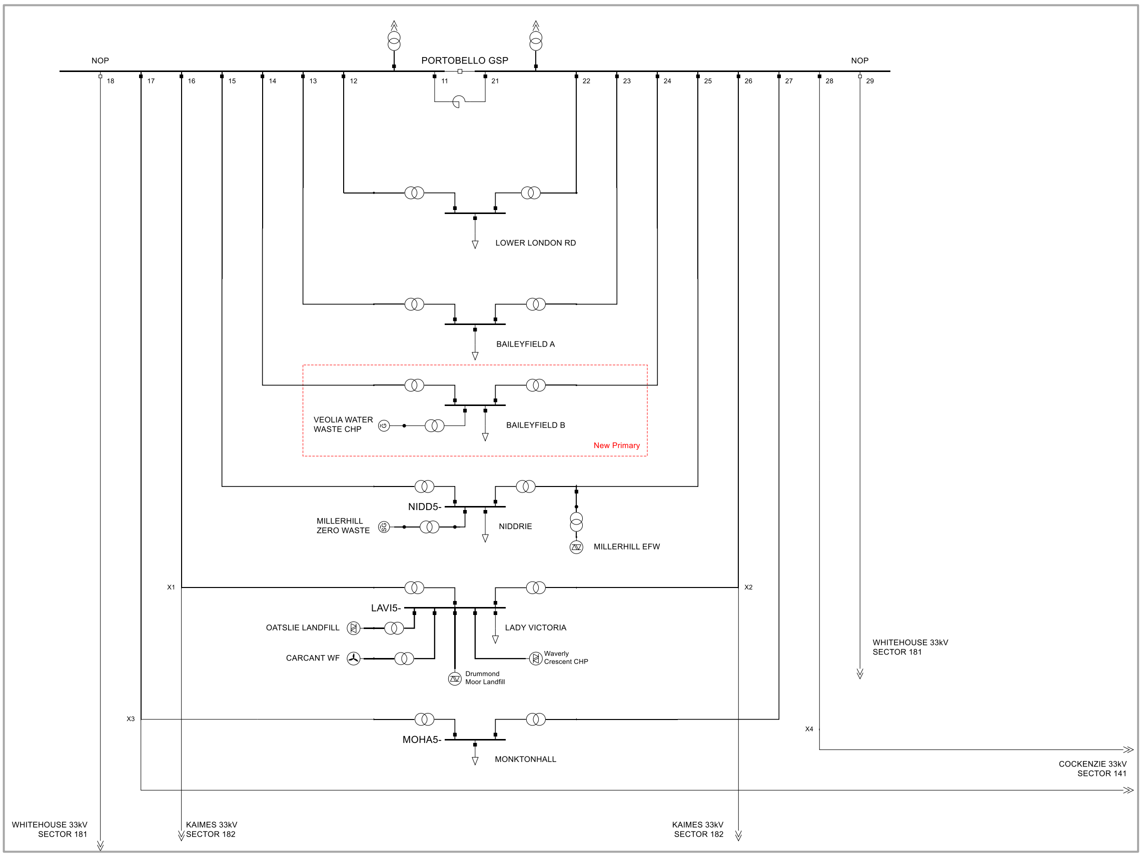

Figure 5. Proposed 33kV network with new Baileyfield Road 'B' primary

Table 5.3 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2.

Table 5.3. Baseline option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	1.22	0.143	0.14	-
6.6/11kV CB (GM) Primary	15	0.416	0.416	-
Wayleaves/Easements/Land Purchase		0.005	0.005	-
Other Costs (Identify Below)		0.030	0.030	-
Total Costs		0.595	0.595	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Installation of fault recorder (30k)				

Due to the predicted increase in fault levels, operational management is not an enduring solution and hence it is proposed to start the works in 2025/26 to revolve the fault level issues, with project completion in 2027/28. We will maintain fault levels at this substation under review and priorities this scheme in earlier years if necessary. The proposed option provides an additional 104MVA (peak make)/81MVA (RMS break) fault level headroom, on equipment rating; and 249MVA (peak make)/153MVA (RMS break), on design rating.

5.2 Option 1 – Replace existing 11kV Switchboard and Primary Transformers

The proposed solution is to replace the existing 11kV switchboard and 33/11kV Primary Transformers with 20MVA units in a new housing. Table 5.14 shows the scheme summary.

Table 5.4. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Portobello Primary Fault Level Mitigation	Replace existing 11kV switchboard and primary transformers	1.124	-

This solution creates additional fault level headroom at Portobello primary substation as shown in 5.

Table 5.5. Option 1 fault levels at Portobello primary substations

Substation Name	Design Rating (kA)		3-phase Fault Levels (kA)		1-Phase Fault Levels (kA)		Max 3-phase & 1-phase Duty (%)	
	Make	Break	Make	Break	Make	Break	Make	Break
Portobello primary	32.80	13.12	24.26	9.52	25.45	9.81	**77.59**	**74.77**

The switchgear and transformers would be replaced within the existing Portobello Primary Substation compound. This proposal creates only 64MVA of additional fault level headroom at Portobello Primary Substation.

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

Table 5.4. Option 1 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Post RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV Transformer (GM)	1	0.369	0.369	-	-
6.6/11kV UG Cable	1.22	0.143	0.143	-	-
6.6/11kV CB (GM) Primary	8	0.222	0.222	-	-
Civil Works at 33kV & 66kV Substations		0.300	0.300	-	-
Wayleaves/Easements/Land Purchase		0.010	0.010	-	-
Other Costs (Identified Below)		0.080	0.080	-	-
Total Costs		1.124	1.124	-	-
Identify activities included within other costs (please provide high-level detail of cost areas)					
Design and Engineering time (£50k)					
Installation of fault recorded (£30k)					

5.3 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5.5.

Table 5.5. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Replace 11kV switchboard and establish Baileyfield Road 'B' primary substation	0.595
Option 1	Replace 11kV switchboard and 33/11kV primary transformers	1.124

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 to replace the existing indoor 11kV switchboard with a new indoor 11kV board and establish a new Baileyfield Road 'B' primary substation.

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-CV3-CBA – Portobello Fault Level Mitigation'.

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 11kV switchboard and establish Baileyfield Road 'B' Primary substation	**Adopted**					
Option 1 – Replace existing 11kV switchboard and 33/11kV transformers	Rejected	Discounted based on NPV.	-0.19	-0.31	-0.38	-0.43

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 £0.595m.

Table 6.2: Summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	1.22	0.143	0.14	-
6.6/11kV CB (GM) Primary	15	0.416	0.416	-
Wayleaves/Easements/Land Purchase		0.005	0.005	-
Other Costs (Identify Below)		0.030	0.030	-
Total Costs		0.595	0.595	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Installation of fault recorder (30k)				

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
CV3 Expenditure	**0.595**	-	-	0.119	0.238	0.238

6.4 Risks

The switchboard replacement is a BaU activity and hence the risks associated with the delivery of the scheme are very minimal. The past track record for delivery of switchgear replacements is presented in the section 5 of Annex 4A.10: Substations & Switchgear; EHV to LV in our RIIO-ED2 business plan.

The delivery of this scheme will be co-ordinated with the delivery of SPD non-load EHV switchgear modernisation (under CV7) for operational efficiencies and minimize the network impact.

All major connections will be secure during the construction period. However, during the changeover from the existing to the proposed system, the demand associated with individual 11kV circuits will be on reduced security of supply. This risk will be minimised by using an offline build approach and having suitable 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 based on the maximum short circuit rating of substation equipment being exceeded.

6.6.2 Payback Periods

The CBA indicates that for the proposed option demonstrates better NPV results in all assessment periods (10, 20, 30 & 45 years) against other options. As the intervention is forecast to carry at least a 45-year asset life expectancy, the CBA at this time justifies the intervention. Consumers will also benefit from reduced network risk immediately on completion of the project.

6.6.3 Sensitivity to Future Pathways

The network capacity and capability that result from the proposed option is consistent with the network requirements determined in line with the section 9 of the Electricity Act and Condition 21. Additionally, the proposed option is consistent with the SPEN's Distribution System Operator (DSO) Strategy and Distribution Future Energy Scenarios.

Table 6.4 shows electric vehicle and heat pump uptakes across a range of future pathways.

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	4,026		4,362	5,215	4,830	3,325	5,255	4,786	4,786
HPs	3,675		3,815	6,172	3,233	2,471	3,718	3,484	3,108

*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 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 6.5: Sensitivity of the proposed solution against future pathways

	RIIO-ED1				RIIO-ED2					RIIO-ED3				
Solution Requirements	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Baseline									R1					
Consumer Transformation									R1					
Leading the Way									R1					
Balanced Net Zero Pathway									R1					
Headwinds									R1					
Widespread Engagement									R1					
Widespread Innovation									R1					
Tailwinds									R1					

R1 – Establish Baileyfield Road 'B' Primary substation and replace existing 11kV switchboard

The proposed solution is robust across all pathways. As this is the minimum requirement to mitigate the fault levels in the group, it is expected that it is insensitive to the future pathways and is expected that proposed solution is required under all the future pathways. In all cases this solution is expected to endure beyond RIIO-ED3.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	Uncertain
RIIO-ED2 Expenditure (£m)	0.595	N/A
Comment	Proposed option	

6.6.4 Asset Stranding Risks & Future Asset Utilisation

Electricity demand and generation loadings are forecast to increase under all scenarios. The stranding risk is therefore considered to be low.

6.6.5 Losses / Sensitivity to Carbon Prices

Losses have been considered in accordance with Licence Condition SLC49 and the SP Energy Networks Losses Strategy and Vision to "consider all reasonable measures which can be applied to reduce losses and adopt those measures which provide benefit for customers". Reasonable design efforts have been taken to minimise system losses without detriment to system security, performance, flexibility or economic viability of the scheme. This includes minimising conductor lengths/routes, the choice of appropriate conductor sizes, designing connections at appropriate voltage levels and avoiding higher impedance solutions or network configurations leading to higher losses.

Losses have been considered as part of this design solution and it has not been necessary to carry out any losses justified upgrades. MWh losses for each of the options have been included within the cost benefit analysis and solution selection was not found to be sensitive to the impact of the carbon cost of losses.

During the evaluation of the options associated with the proposed scheme, we have embedded within the CBA, where data are available, an assessment of the embodied carbon and the associated carbon cost to inform our NPV evaluation. The mass of carbon dioxide emitted (CO2e) during the manufacture of the main equipment deployed to deliver this scheme is estimated to be 43 tonnes. The monetised embodied carbon value associated with this emission is £2.9k. 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[2].

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.

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

6.7 Environmental Considerations

6.7.1 Operational and Embodied Carbon Emissions

The Portobello Primary Substation Fault Level Mitigation programme has the potential to impact on the embodied carbon resulting from manufacture and supply of components required for the delivery of the programme. There is likely to be a little or no impact on operational emissions within SPEN's Business Carbon Footprint (BCF).

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts of the Portobello Primary Substation Fault Level Mitigation 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 Portobello Primary Substation Fault Level Mitigation programme will result in the consumption of resources and the generation of waste materials from end of life assets.

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

6.7.4 Biodiversity / Natural Capital

The Portobello Primary Substation Fault Level Mitigation programme will only affect a single developed site containing existing assets. Therefore, the impact on, and the opportunity to improve biodiversity and natural capital is expected to be minimal.

6.7.5 Preventing Pollution

SPEN will always follow all relevant waste regulations and will make sure that special (hazardous) waste produced or handled by our business is treated in such a way as to minimise any effects on the environment.

6.7.6 Visual Amenity

SPEN continually seeks to reduce the landscape and visual effects of our networks and assets. However, as the Portobello Primary Substation fault level mitigation programme consists of works within existing substation buildings, there is anticipated to be little or no impact on visual amenity.

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

Portobello 33/11kV primary group is located in Edinburgh & Borders district. The group currently serves 22,310 customers.

The peak-make and the RMS break duty fault levels at Portobello primary 11kV already exceed the design fault level limits (250MVA) and are at around 120%. While this is currently within the design rating of the primary substation switchgear it puts the wider 11kV network at risk as other networks switchgear will not be rated for this high fault level.

In order to continue to maintain a safe and secure network, the proposed fault level mitigation solution is to establish a new Baileyfield Road 'B' Primary substation with two 12/24MVA 33/11kV transformers and a 15-panel 11kV switchboard, located in a housing. Baileyfield Road 'B' primary will be connected a new circuit breaker connected at 33kV to the Portobello Grid Supply Point (GSP) 33kV busbar.

The estimated cost for the above is £0.595m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

In order to resolve the fault level issues and enable future connections, it is proposed to continue the works and the fault level scheme output will be claimed in 2027/28 at the end of the project. The proposed option provides an additional 104MVA (peak make)/81MVA (RMS break) fault level headroom, on equipment rating; and 249MVA (peak make)/153MVA (RMS break), on design rating.