Yair Bridge 22kV Upgrade

ED2 Engineering Justification Paper

ED2-LRE-SPD-027-CV1-EJP

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

Scheme Name	Yair Bridge 22kV Upgrade		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-027-CV1		
Output	Load Index		
Cost	£5.381m		
Delivery Year	2023-2026		
Reporting Table	CV1		
Outputs included in ED1	~~Yes~~/No		
Business Plan Section	Develop the Network of the Future		
Primary Annex	Annex 4A.2: Load Related Expenditure Strategy: Engineering Net Zero Annex 4A.6: DFES		
Spend Apportionment	**ED1**	**ED2**	**ED3**
	£m	**£5.381m**	**£m**

SP ENERGY NETWORKS

SP ENERGY NETWORKS

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:	**Yair Bridge 22kV Upgrade**
Project Reference:	**ED2-LRE-SPD-027-CV1**
Decision Required:	**To give concept approval for the project scope of installing a second circuit to Innerleithen to release capacity at Kingsland, address customer issues and provide the least cost solution for modernising the ageing network.**

Summary of Business Need:

The area is served by a legacy area of network, primarily running at 22kV and 6.6kV. Kingsland is LI4 and projected to reach LI5 in 2029. 22kV primaries supplied by Yair Bridge / Kingsland are at single circuit risk and therefore are vulnerable to transient and permanent faults on the 27km of 22kV main line that supplies them.

In addition to the forecasted load issues, ageing legacy assets and civils require remedial works. The civils are of particular concern due to flood risk in the area.

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

The following works are proposed for the first three years of RIIO-ED2:

- Install second extra high voltage (EHV) circuit to Innerleithen. This will offload Kingsland and prevent loss of supply for a single transient or permanent fault.
- Remove Walkerburn primary and feed the customers from the Innerleithen secondary network. This is the least cost option to increase security of supply to the customers and manage the asset and flooding issues present.

The estimated cost for the above is £5.381m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

Expenditure Forecast (in 2020/21)

Licence Area	Reporting Table	Description	Total (£m)	Incidence (£m)				
				2023/24	2024/25	2025/26	2026/27	2027/28
SPD	CV1	Primary Reinforcement	**5.381**	2.152	2.690	0.538	-	-
SPD	**Total**		**5.381**	2.152	2.690	0.538	-	-

PART B – PROJECT SUBMISSION

Proposed by	Jonathan Fox	Signature	J Fox	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

The network area is geographically located within the Edinburgh & Borders region of SP Distribution (SPD) licence area. The groups supply a number of primary substations and currently serves ca. 2,413 customers.

The Yair Bridge / Innerleithen area is served by a legacy area of network, primarily running at 22kV and 6.6kV. It is fed from two ends – Kingsland Primary and Yair Bridge Primary. Kingsland is currently at limits (HI4) and load is forecast to further increase during the RIIO-ED2 period.

Furthermore, both Innerleithen and Walkerburn Primaries are at single circuit risk as closing a normally open point between Yair Bridge and Kingsland would cause a grid parallel. With approximately 27km of 22kV main line (plus spurs) between Yair Bridge and Gytes substation running close to water, transient faults such as bird strikes are very common. This causes supply interruptions after a single fault that can only be partially mitigated by automation, tree cutting and asset modernisation.

In addition to the expected load issues, the ageing legacy assets and civils require remedial works. The civils are of particular concern due to the substantial flooding issues.

The following works are proposed for the first three years of RIIO-ED2:

- Install second EHV circuit to Innerleithen. This will offload Kingsland and prevent loss of supply for a single transient or permanent fault.
- Remove Walkerburn primary and feed the customers from the Innerleithen secondary network. This is the least cost option to increase security of supply to the customers and manage the asset and flooding issues present.

SP Energy Networks have received the approval of stakeholders including the Innerleithen and Walkerburn Community Councils for this proposal.

The estimated cost for the above carryover work packages is £5.381m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

It is proposed to start the works in early RIIO-ED2 and 7.5MVA of capacity release will be claimed in 2025/26 at the end of the project.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is the distribution network between Yair Bridge and Kingsland. It is a non-standard network made up of four voltages: 33kV & 22 kV (EHV) and 11kV & 6.6kV (HV).

There are two smaller primaries fed from the 22kV network (Walkerburn & Innerleithen) plus 89 22/LV pole mounted transformers. Gytes substation houses SP Distribution's only network step up transformer from 11kV to 22kV.

The network area and diagrams are shown in the figures below.

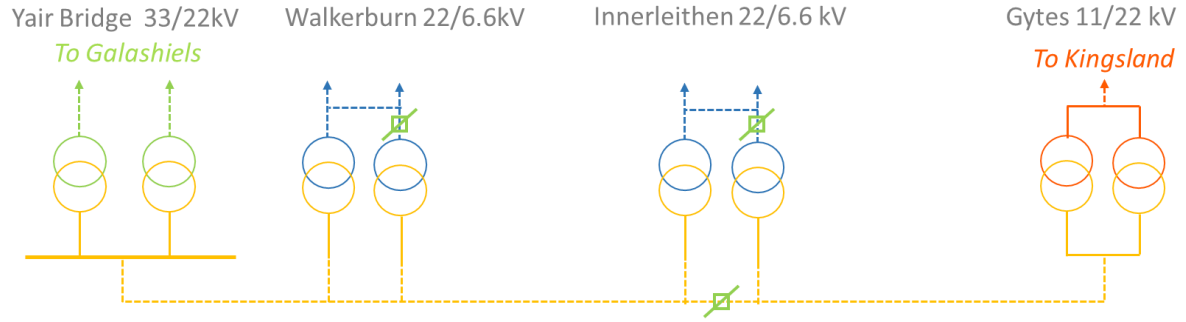

Figure 1. Existing 22kV Network (Green=33kV, Yellow=22kV, Red=11kV, Blue=6.6kV, Green Box with Strikethrough=Normally open point)

Figure 2. Geographical Area

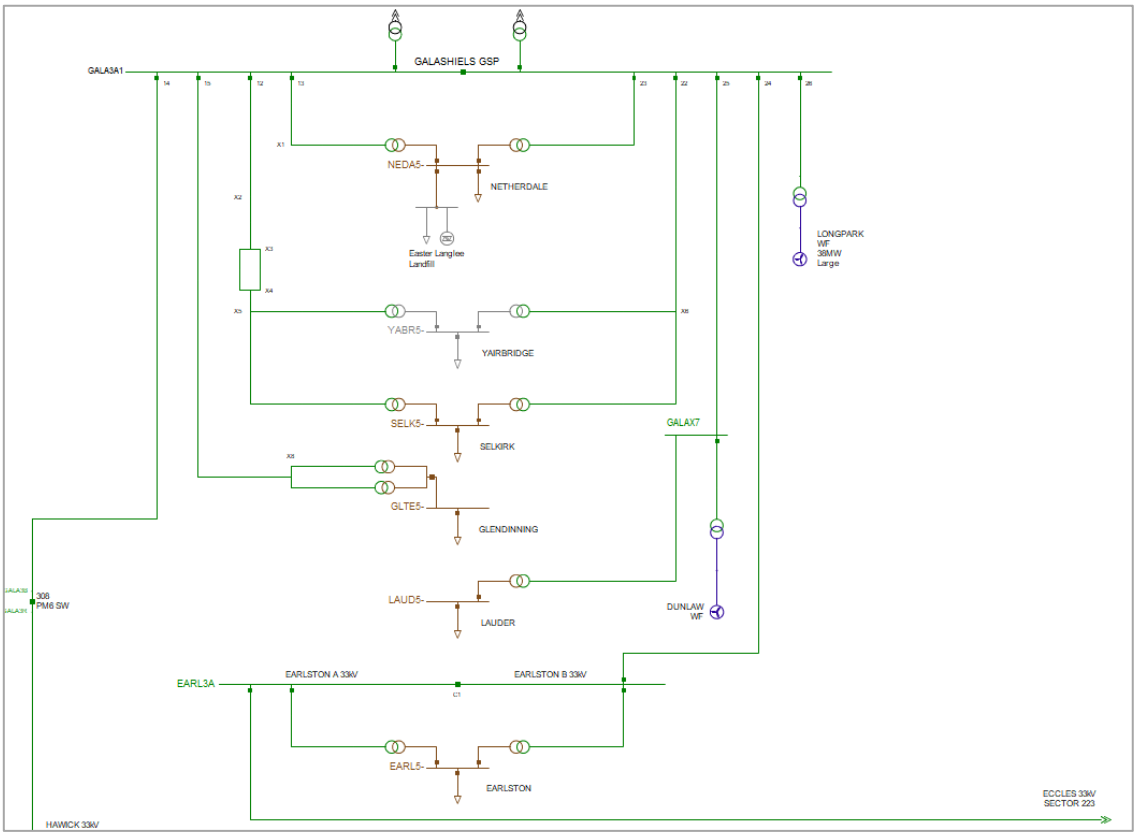

Figure 3. Galashiels GSP Network

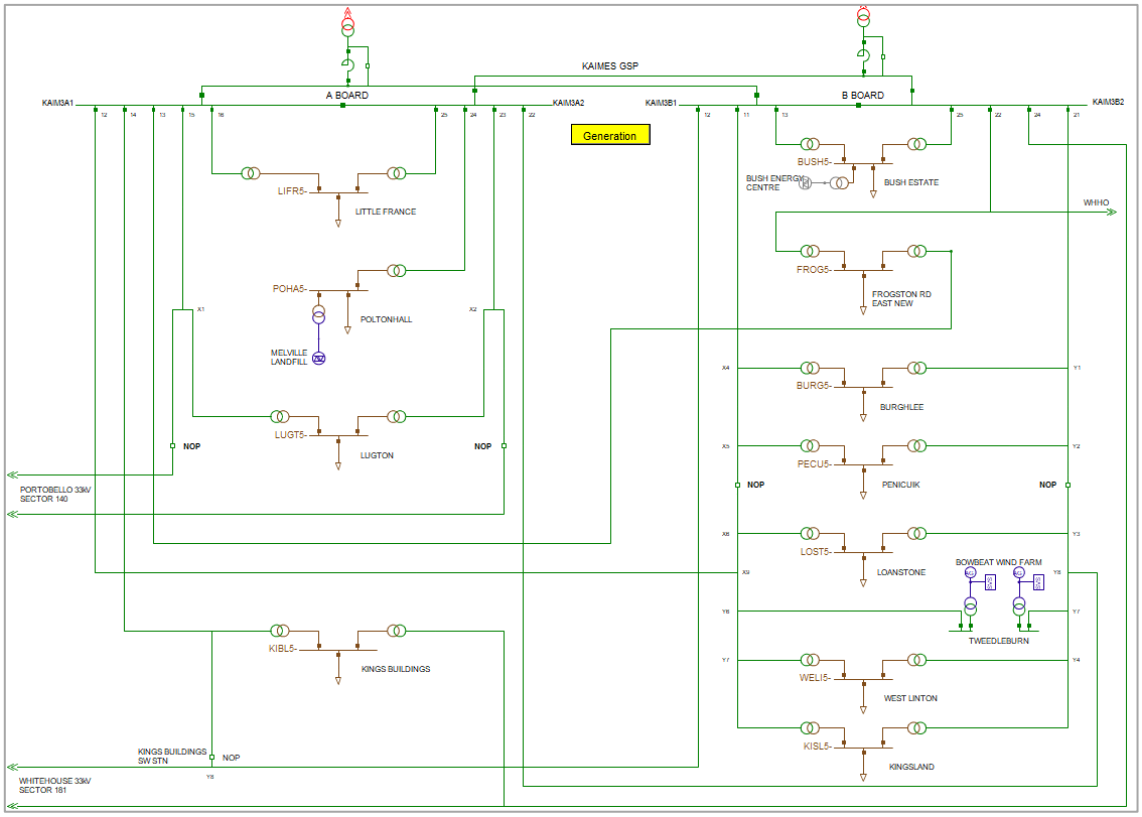

Figure 4. Kaimes GSP Network

2.2 Group Demand & Security of Supply

The 2021 maximum demand for Yair Bridge and Kingsland is shown in Table 2.1. All demand groups are currently a class 'B' of supply as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7.

Table 2.1. Govan / St. Andrews Cross GSP primary group demands under review (2021 Load Index)

Demand Group	Customers (#)	Firm Capacity (MVA)	Max Demand (MVA)	Load Index	P2/7 Class of Supply
Yair Bridge	2,413	7.5	2.1	LI1	B
Kingsland	5,947	10	10.1	LI4	B

2.3 Embedded Generation

There is no significant embedded generation connected at primary substations under consideration (Yair Bridge, Innerleithen, Walkerburn, Kingsland primary substations).

2.4 Fault Levels

Studies indicate that there are no fault level issues at primary substations under consideration (Yair Bridge, Innerleithen, Walkerburn, Kingsland primary substations).

3 Needs Case

The Yair Bridge / Innerleithen area is served by a legacy area of network, primarily running at 22kV and 6.6kV. It is fed from two ends – Kingsland Primary and Yair Bridge Primary. Kingsland is currently at limits (HI4) and load is forecast to further increase during the RIIO-ED2 period.

The non-standard voltage network results in limits system capacity and additional reinforcement needs (e.g. 6.6kV cables overloading before their 11kV equivalent) and incremental costs for dual ratio equipment for plant installations and replacements. The diminishing population of plant also presents risks from the perspective of fault repairs and the availability of spares.

Furthermore, both Innerleithen and Walkerburn are at single circuit risk as closing a normally open point between Yair Bridge and Kingsland would cause a grid parallel. With approximately 27km of 22kV main line (plus spurs) between Yair Bridge and Gytes running close to water, transient faults such as bird strikes are very common. This causes supply interruptions after a single fault that can only be partially mitigated by automation, tree cutting and asset modernisation.

In addition to the expected load issues, the ageing legacy assets (see table below) and civils require remedial works. The civils are of particular concern due to the substantial flooding issues.

Table 3.1. Asset Health

Substation	Switchgear	Transformers
Galashiels GSP	12 x 33kV CBs Type: Hawker Siddley HG36 installed in 1994 and 2009 Busbar rating: 2,000A Health index: HI1	T1 132/33kV 45MVA and T2 132/33kV 90MVA Type: T1 Parsons installed in 1959 and T2 ABB installed in 2017 Health index: HI4 and HI1
Yair Bridge Primary	3 x 22kV, CBs, 5 x 33kV ABSWs and 2 x fault throwers Type: Reyrolle ORT2 installed in 1960 Busbar rating: 800A Health index: HI5	2 x 33/22kV 7.5MVA Type: Hackbridge and Hewittic installed in 1960 Health index: HI5
Innerleithen Primary	6 x 6.6kV CBs Type: South Wales C8X, D12P and C4X installed in 1974 Busbar rating: 800A Health index: HI2 and HI5	2 x 22/6.6kV 7.5MVA Type: Bryce transformers installed in 1974 Health index: HI5
Walkerburn Primary	2 x 6.6kV RMUs Type: Long and Crawford T3GF3 installed in 1985 Busbar rating: 630A Health index: HI3	T1 22/6.6kV 1MVA and T2 22/6.6kV 2MVA Type: T1 Ferranti installed in 1982 and T2 Johnson and Phillips installed in 1985 Health index: HI5 and HI4
Gytes Primary	3 x 22kV ABSWs and 1 x fault thrower 1 x 11kV CB Type: Yorkshire IVIF Health Index: HI5	2 x 22/11kV 3MVA (star/star transformer) Type: Bruce Peebles installed in 1950 Health index: HI5

3.1 Forecast Demand

The system is forecast to grow and exceed firm capacity within the RIIO-ED2 period. This forecast is based on actual system measurement data from the Process Instrumentation (PI) system and stakeholder endorsed Distribution Future Energy Scenarios (DFES) and considers our pipeline of known developments.

3.1.1 Distribution Future Energy Scenarios

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

The peak demand forecast based on the SPD Distribution Future Energy Scenarios along with the projected demand from authorised connections is depicted in Figure 5 and Figure 6.

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.

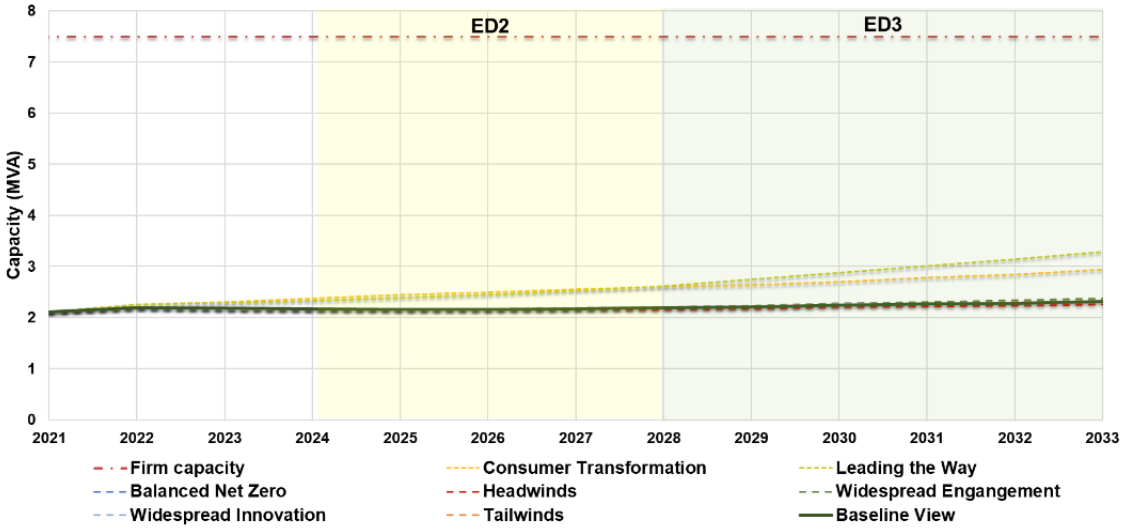

Figure 5. Demand (MVA) forecast for Yair Bridge

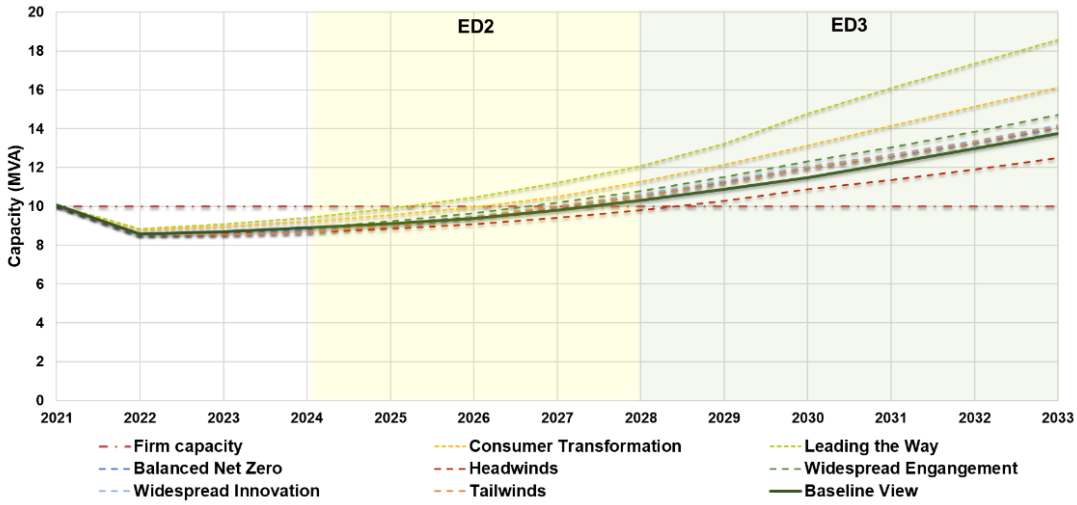

Figure 6. Demand (MVA) forecast for Kingsland

3.1.2 Baseline View

For the primary substations requiring reinforcement within the Yair Bridge / Kingsland area, the forecast demand growth under our Baseline scenario, along with the firm capacity and utilisation through to RIIO-ED3 period is shown in Table 3.2.

Table 3.2. Baseline View forecast

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Yair Bridge													
Forecast Demand (MVA)	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.1	2.2	2.2	2.2
Firm Capacity (MVA)	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Utilisation (%)	28	28	28	27	27	27	27	28	28	28	29	29	29
Load Index	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1	LI1
Kingsland													
Forecast Demand (MVA)	10.1	8.58	8.70	8.89	9.11	9.37	9.79	10.3	10.9	11.5	12.2	13.0	13.8
Firm Capacity (MVA)	10	10	10	10	10	10	10	10	10	10	10	10	10
Utilisation (%)	101	85.8	87	88.9	91.1	93.7	97.9	103	109	115	122	130	138
Load Index	LI4	LI2	LI2	LI2	LI2	LI2	LI3	LI4	LI5	LI5	LI5	LI5	LI5

3.2 Network Impact Assessment

Detailed network studies covering network intact and outage (N-1) conditions and fault level assessments were carried out for the primary substations requiring reinforcement within the Yair Bridge / Kingsland area considering the different demand forecast scenarios.

3.2.1 Thermal Constraints

Table 3.3 shows the identified thermal constraints on the 33/6.6kV network level.

Table 3.3. Thermal constraints at 33/6.6kV level

Network Item	Voltage	Outage
Yair Bridge T1	33/22kV	N-1
Yair Bridge T2	33/22kV	N-1
Innerleithen T1	22/6.6kV	N-1
Innerleithen T2	22/6.6kV	N-1
Walkerburn T1	22/6.6kV	N-1
Walkerburn T2	22/6.6kV	N-1
Kingsland T1	33/11kV	N-1
Kingsland T2	33/11kV	N-1
Gytes T1	11/22kV	N-1
Gytes T2	11/22kV	N-1

3.2.2 Voltage Constraints

There were no voltage constraints the network fed from the Yair Bridge, Innerleithen or Walkerburn primary demand groups.

3.2.3 EREC P2/7 – Security of Supply

The peak demand and firm capacity of the primary substations requiring reinforcement within the Yair Bridge / Kingsland area are shown in Table 3.2.

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

a) Group demand minus 1MW must be met within 3 hours;
b) Group demand must be met within repair time.

Therefore, based on the minimum demand requirements to be met under FCO conditions and the available firm capacity this site is predicted to be non-compliant under EREC P2/7 by the end of the RIIO-ED2 price control period.

4 Optioneering

Table 4.1 shows a summary of the options considered for this reinforcement. The baseline represents the lowest cost conventional option, i.e. the minimum level of intervention without application of innovation.

Innovation including the use of battery systems was considered and projects such as SSE's "Resilience as a service" were evaluated for suitability for this network area. However, this was deemed to be cost ineffective and would carry significant risk compared to the conventional options.

Table 4.1. Longlist of solution options

#	Options	Status	Reason for rejection
(a)	Do nothing	Rejected	Rejected as it does not address the thermal headroom issues and leads end of life electrical & civils assets on the system
(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 like for like	Rejected	Rejected as it does not address the thermal issues from accepted connections and future network growth
(d)	Install second circuit to Innerleithen and remove Walkerburn Primary	Shortlisted as **Baseline** option in Detailed Analysis	
(e)	Uprate equipment to standard voltages	Shortlisted as **Option 1** in Detailed Analysis	

5 Detailed Analysis & Costs

5.1 Proposed Option (Baseline) – Install second circuit to Innerleithen and remove Walkerburn Primary

This solution proposes to offload Kingsland by running a second circuit to Innerleithen and secure customers at Walkerburn by looping them into the Innerleithen secondary network. This solution also provides the least cost for managing the ageing assets on the network and reduces spend on flood mitigation.

The following works are proposed for the first three years of RIIO-ED2:

- Install second extra high voltage (EHV) circuit to Innerleithen. This will offload Kingsland and prevent loss of supply for a single transient or permanent fault.
- Remove Walkerburn primary and feed the customers from the Innerleithen secondary network. This is the least cost option to increase security of supply to the customers and manage the asset and flooding issues present.

SP Energy Networks have received the approval of stakeholders including the Innerleithen and Walkerburn Community Councils for this proposal.

Table 5.1. Baseline summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Yair Bridge Reinforcement	Install second circuit to Innerleithen and remove Walkerburn Primary	5.381	-

5.1.1 Proposed Network

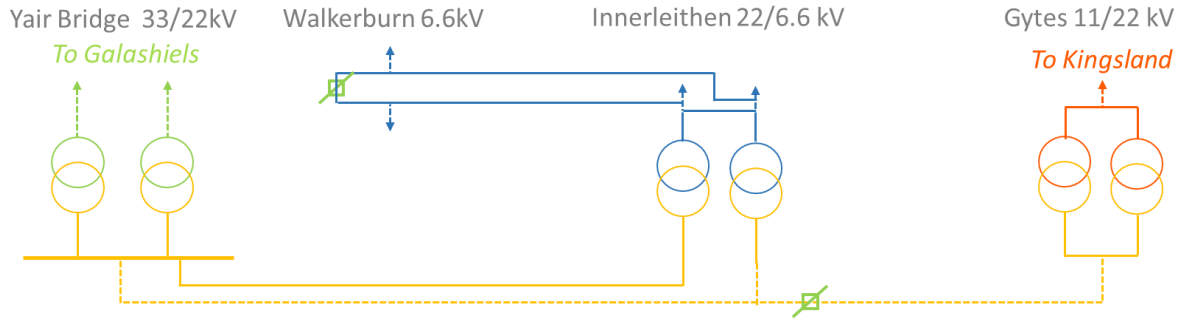

Figure 7. Proposed Network Configuration

5.1.2 Data Tables

Table 5.2 details the breakdown of the project spends and Table 5.3 shows capacity outputs across the RIIO-ED2 period.

Table 5.2. Baseline option project spends

Work Package	Work Package Name	Reporting Table	Project Forecast (£m)	RIIO-ED1 (£m)	RIIO-ED2 (£m)	Incidence (£m)				
						2023/24	2024/25	2025/26	2026/27	2027/28
1	Yair Bridge Reinforcement	CV1	5.381	0	5.381	2.152	2.690	0.538	0	0
Total			5.381	0	5.381	2.152	2.690	0.538	0	0

Table 5.3. Baseline option RIIO-ED2 capacity released

Work Package	Work Package Name	Capacity Released RIIO-ED2
1	Yair Bridge Reinforcement	**7.5**

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

Table 5.4. 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	7.50	0.881	0.881	-
6.6/11kV RMU	3.00	0.074	0.074	-
33kV UG Cable (Non Pressurised)	18.00	3.593	3.593	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	1.00	0.167	0.167	-
Civil Works at 33 kV & 66 kV Substations		0.012	0.012	-
Other Costs (Identify Below)		0.654	0.654	-
Total Costs		5.381	5.381	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Design and engineering time (£50k)				
Directional drill (£300k)				
Dispose of Walkerburn Primary (£150k)				
Environmental works (£13k)				
Remote end protection (£21k)				
SCADA (£5k)				

5.2 Option 1 – Uprate equipment to standard voltages

This solution proposes to uprate the network to standard voltages to offload Kingsland, increase network capacity and address asset issues. This would consist of the following:

- Uprate Innerleithen and Walkerburn Primaries to 33/11kV
- Install two new 33kV cables from Yair Bridge to Innerleithen tee Walkerburn
- Uprate the Innerleithen and Walkerburn secondary networks to 11kV
- Run the existing 22kV OHL at 11kV and convert the PTEs to standard 11/LV models

Table 5.5. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Yair Bridge Reinforcement	Uprate equipment to standard voltages	12.054	-

5.2.1 Data Tables

Table 5.6 details the breakdown of the project spends and Table 5.7 shows capacity outputs across the RIIO-ED2 period.

Table 5.6. Option 1 project spends

Work Package	Work Package Name	Reporting Table	Project Forecast (£m)	RIIO-ED1 (£m)	RIIO-ED2 (£m)	Incidence (£m)				
						2023/24	2024/25	2025/26	2026/27	2027/28
1	Yair Bridge Reinforcement	CV1	12.054	0	12.054	4.822	6.027	1.205	-	-
Total			12.054	0	12.054	4.822	6.027	1.205	-	-

Table 5.7. Option 1 RIIO-ED2 capacity released

Work Package	Work Package Name	Capacity Released RIIO-ED2
1	Yair Bridge Reinforcement	**20**

Table 5.8 shows a summary of reinforcement costs and volumes for option 1 under RIIO-ED2.

Table 5.8. Option 1summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV UG Cable	0.60	0.070	0.070	-
6.6/11kV CB (GM) Primary	8.00	0.222	0.222	-
6.6/11kV RMU	19.00	0.471	0.471	-
6.6/11kV Transformer (PM)	132.00	0.793	0.793	-
6.6/11kV Transformer (GM)	19.00	0.273	0.273	-
33kV UG Cable (Non Pressurised)	36.20	7.226	7.226	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	2.00	0.334	0.334	-
33kV Transformer (GM)	4.00	1.477	1.477	-
Batteries at 33kV Substations	2.00	0.018	0.018	
Pilot Wire Underground	0.20	0.022	0.022	-
Civil Works at 33 kV & 66 kV Substations		0.392	0.392	-
Other Costs (Identify Below)		0.755	0.755	-
Total Costs		12.054	12.054	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Design and engineering time (£150k)				
Termination kit and protection (£40k)				
Directional drill (£300k)				
Environmental works (£13k)				
REP (£42k)				
SCADA (£10k)				
Flood mitigation (£200k)				
Design and engineering time (£150k)				

6 Deliverability & Risk

6.1 Preferred Options & Output Summary

The adopted option is the baseline option to run a second EHV circuit and remove Walkerburn Primary.

6.2 Cost Benefit Analysis Results

A cost benefit analysis (CBA) was carried out to compare the net present value (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-027-CV1-CBA – Yair Bridge'.

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 - Install second circuit to Innerleithen and remove Walkerburn Primary.	**Adopted**					
Option 1 - Uprate equipment to standard voltages.	Discounted	Discounted based on NPV	-3.78	-5.17	-6.05	-6.65

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 £5.381m.

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	7.50	0.881	0.881	-
6.6/11kV RMU	3.00	0.074	0.074	-
33kV UG Cable (Non Pressurised)	18.00	3.593	3.593	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	1.00	0.167	0.167	-
Civil Works at 33 kV & 66 kV Substations		0.012	0.012	-
Other Costs (Identify Below)		0.654	0.654	-
Total Costs		5.381	5.381	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Design and engineering time (£50k)				
Directional drill (£300k)				
Dispose of Walkerburn Primary (£150k)				
Environmental works (£13k)				
Remote end protection (£21k)				
SCADA (£5k)				

Table 6.3: Cost incidence over the RIIO-ED2 period, £m (2020/21 Prices)

Total Investment	Total RIIO-ED1 (£m)	Total RIO-ED2 (£m)	Incidence (£m)				
			2023/24	2024/25	2025/26	2026/27	2027/28
CV1 Expenditure	0	5.381	2.152	2.690	0.538	0.000	0.000

6.4 Risks

The two main risks are associated with the cable laying activities:

1) A directional drill is required to cross the River Tweed as the bridges are deemed to be too weak to support the cables. This has been mitigated through assessment of the route and using experience of previous directional drill projects to determine costs and viability.
2) The route length is significant and therefore wayleaves could add unforeseen expense and time to the project. This is mitigated through using the verge of the A72 for the majority of the route and by approval of the plan by the local community councils.

6.5 Outputs Included in RIIO-ED1 Plans

There are no capacity release volumes associated with these work packages included within the RIIO-ED1 period.

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 the other solution. 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 for Yair Bridge and Kingsland Primary

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	2,067		2,311	2,717	2,480	1,707	2,698	2,457	2,457

HPs	678		826	1,455	543	574	590	466	566

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

R1 – Upgrade network with second circuit

The proposed solution is to resolve a network security constraint and is robust across the range of future pathways. The proposed solution is expected to be required under all scenarios and in all cases to endure well beyond RIIO-ED3.

Table 6.6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	**Uncertain**
RIIO-ED2 Expenditure (£m)	5.381	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.

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 (CO_2e) during the manufacture of the main equipment deployed to deliver this scheme is estimated to be 231 tonnes. The monetised embodied carbon value associated with this emission is £11.2k. It should be noted that

the embodied carbon evaluation undertaken has only considered the manufacture and supply of materials. Further collaborative industry-wide work is planned for the RIIO-ED2 price review period to better understand the overall embodied carbon values including, for example installation and commissioning services, decommissioning and disposal activities as well as refurbishment opportunities. More information regarding this can be found in Section 3.1.2 of our Environmental Action Plan[1].

6.6.6 Whole Systems Benefits

Whole system solutions have been considered as part of this proposal. No alternatives have been identified that could be provided through a whole systems solution. The completion of this scheme will maintain the integrity of the distribution network and its enduring ability to facilitate wider whole system benefits.

6.7 Environmental Considerations

6.7.1 Operational and Embodied Carbon Emissions

The Yair Bridge Reinforcement programme has the potential to impact on the embodied carbon resulting from the delivery of the programme, including for example from the installation of new transformers and from remedial civils works.

Upfront costs associated with replacement assets (e.g. embodied carbon in the materials and emissions associated with civil engineering works) should be considered against the potential operational efficiency improvements associated with replacement assets from a lifetime carbon perspective. For example, with the carbon emissions resulting from the raw materials and manufacture of new assets only contributing around 5-10% of the whole-life carbon impact of a transformer, it is entirely possible that a transformer with a higher embodied carbon footprint may have lower whole-life carbon emissions if it can operate more efficiently with fewer losses.

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

6.7.2 Supply Chain Sustainability

For us to take full account of the sustainability impacts of the Yair Bridge Reinforcement programme, we need access to reliable data from our suppliers, including information on the embodied carbon from the manufacture of transformers, and on the fixed and variable losses from their operation. 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 Yair Bridge Reinforcement programme will result in the consumption of resources and the generation of waste materials from end of life assets.

Where waste is produced it will be managed in accordance with the waste hierarchy which ranks waste management options according to what is best for the environment. The waste hierarchy gives

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

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 Yair Bridge Reinforcement programme will only deploy plant at sites 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 but recognises that the nature of our substations makes it challenging to minimise their visual impact.

As the route shall be cabled, there will be no additional visual amenity impact. Furthermore, the site at Walkerburn Primary shall be fully cleared.

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

Load growth within the network area is constrained by the feed from Kingland Primary which is forecast to be LI4 within the RIIO-ED2 period and LI5 by 2029. Innerleithen and Walkerburn Primaries are currently fed from a long overhead line which is at single circuit risk.

Additionally, many of the plant assets within the area are reaching end of life and flooding issues are present. The proposed load works will mitigate the requirement to intervene many of these issues by removing assets or installing replacement assets to alleviate network constraints.

The following works are proposed for the first three years of RIIO-ED2:

- Install second EHV circuit to Innerleithen. This will offload Kingsland and prevent loss of supply for a single transient or permanent fault.
- Remove Walkerburn primary and feed the customers from the Innerleithen secondary network. This is the least cost option to increase security of supply to the customers and manage the asset and flooding issues present.

SP Energy Networks have received the approval of stakeholders including the Innerleithen and Walkerburn Community Councils for this proposal.

The estimated cost for the above is £5.381m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. In order to resolve the forecast thermal issues, it is

proposed to continue the works during RIIO-ED2 and the release capacity of 7.5MVA will be claimed in 2025/26 at the end of the project.