Levenbank Primary Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPD-001-CV1-EJP

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

Scheme Name	Levenbank Primary Reinforcement		
Activity	Primary Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPD-001-CV1		
Output	Load Index		
Cost	£1.219m		
Delivery Year	2023-2025		
Reporting Table	CV1		
Outputs included in ED1	~~Yes~~/No		
Business Plan Section	Develop the Network of the Future		
Primary Annex	Annex 4A.2: Load Related Expenditure Strategy: Engineering Net Zero Annex 4A.6: DFES		
Spend Apportionment	**ED1**	**ED2**	**ED3**
	£m	**£1.219m**	**£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:	**Levenbank Primary Reinforcement**
Project Reference:	**ED2-LRE-SPD-001-CV1**
Decision Required:	**To give concept approval for the project scope of replacing the existing 10MVA transformers at Levenbank primary with new 20MVA units.**

Summary of Business Need:

The loading at Levenbank Primary demand group is presently approaching the firm capacity of the network. Distribution Future Energy Scenario forecasts further load growth in the area and predicts that, by 2028, the demand will exceed the firm capacity of the group. In order to secure supplies within the group, meet the licence obligations under EREC P2/7 – Security of Supply; and to accommodate future demand growth within the area, it is proposed to carry out system reinforcement in the RIIO-ED2 price control period.

Further, in order to comply with section 9 of the Electricity Act and Condition 21 of our licence obligation "to develop and maintain an efficient, coordinated and economical system for the distribution of electricity" an enduring design solution is required in order to satisfy the existing demand requirements and accommodate future load growth. This concept paper covers the 11kV network capacity constraints and solutions required to accommodate these development plans.

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

Proposed works at 33/11kV are to replace the existing 10MVA transformers at Levenbank primary with new 20MVA units and procure flexibility services to manage the network risk through the delivery stage at a cost of £50k.

The estimated cost for the above is £1.219m (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	**1.169**	0.935	0.234	-	-	-
SPD	CV1	Flexible Services	**0.050**	0.020	0.030	-	-	-
SPD	**Total**		**1.219**	**0.955**	**0.264**	**-**	**-**	**-**

PART B – PROJECT SUBMISSION

Proposed by	Mark Friese	Signature		Date:	30/11/2021
Endorsed by	Russell Bryans	Signature		Date:	30/11/2021

PART C – PROJECT APPROVAL

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

Contents

1 Introduction

Levenbank 33/11kV primary group is geographically located in the Central & Fife region of SP Distribution (SPD) licence area. The group supplies to Leven town and currently serves ca. 3,417 customers.

Historically, the group demand at Levenbank primary has approached, or exceed, the 10MVA firm capacity of the group. Our Baseline View forecasts a peak demand of 11.0MVA by 2028, with an expected uptake of up to 369 electric vehicles and 612 heat pumps by the end of the RIIO-ED2 period. Levenbank demand group is a class 'B' of supply as per ENA Engineering Recommendation (EREC) P2/7.

In order to secure supplies within the group, meet the licence obligations under EREC P2/7 – Security of Supply and to accommodate future demand growth within the area, it is proposed to carry out system reinforcement in the RIIO-ED2 price control period. Proposed works at 33/11kV are to replace the existing 10MVA transformers at Levenbank primary with new 20MVA units and procure £50k of flexibility services to facilitate market growth and manage the network risk through the delivery stage of the project. It is recommended to continue annual tendering for flexibility in this area to procure enough capacity and review the proposed conventional/build solutions or in the likely case of additional demand uptake in the group.

The estimated cost for the above is £1.219m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

The timing of the project is based on delivering the highest NPV savings, while maintaining security of supply. The baseline view forecasts an operationally manageable level of demand during project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 10MVA released in 2024/25, upon completion of the proposed works.

2 Background Information

2.1 Existing / Authorised Network

The network under consideration is Levenbank Primary 11kV demand group. The existing 11kV network comprises mainly underground cable (UGC) with some small sections of overhead line (OHL). Levenbank primary is interconnected at 11kV with Durie House, Leven and Methilhill substations, as shown in Figure 1.

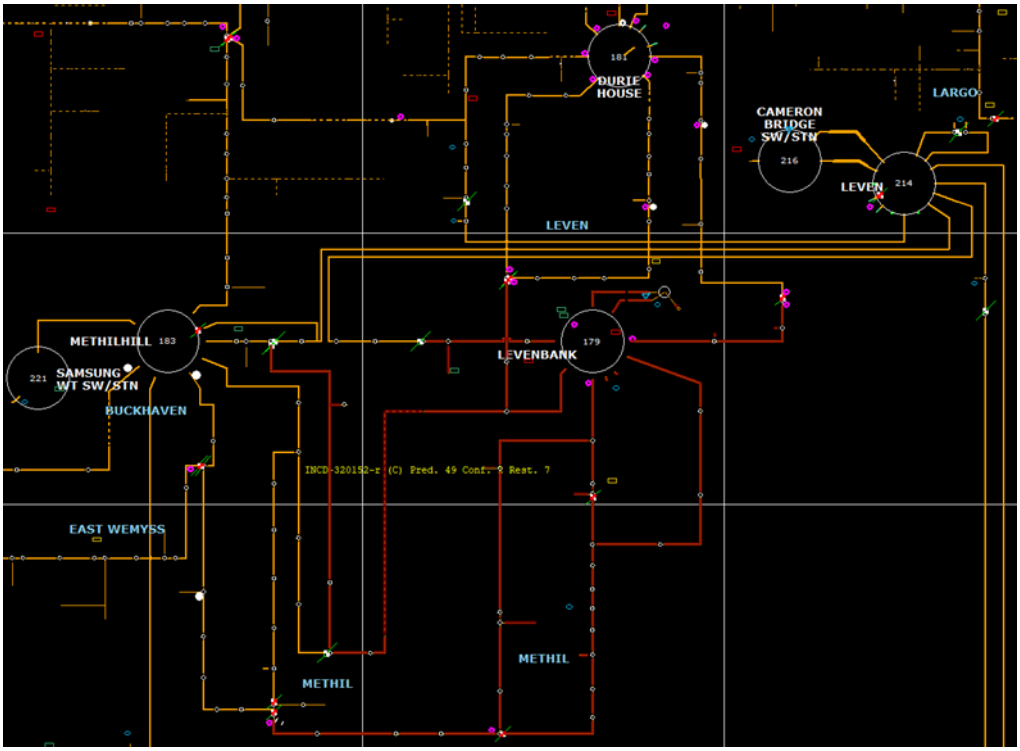

Figure 1. Existing 11kV Network

Levenbank primary substation is served by two 10MVA, Bonar Logan M21 AX 4T, 33/11kV transformers (1958). The HV group is fed from Leven Grid Supply Point (GSP) via the 33kV network shown in Figure 2.

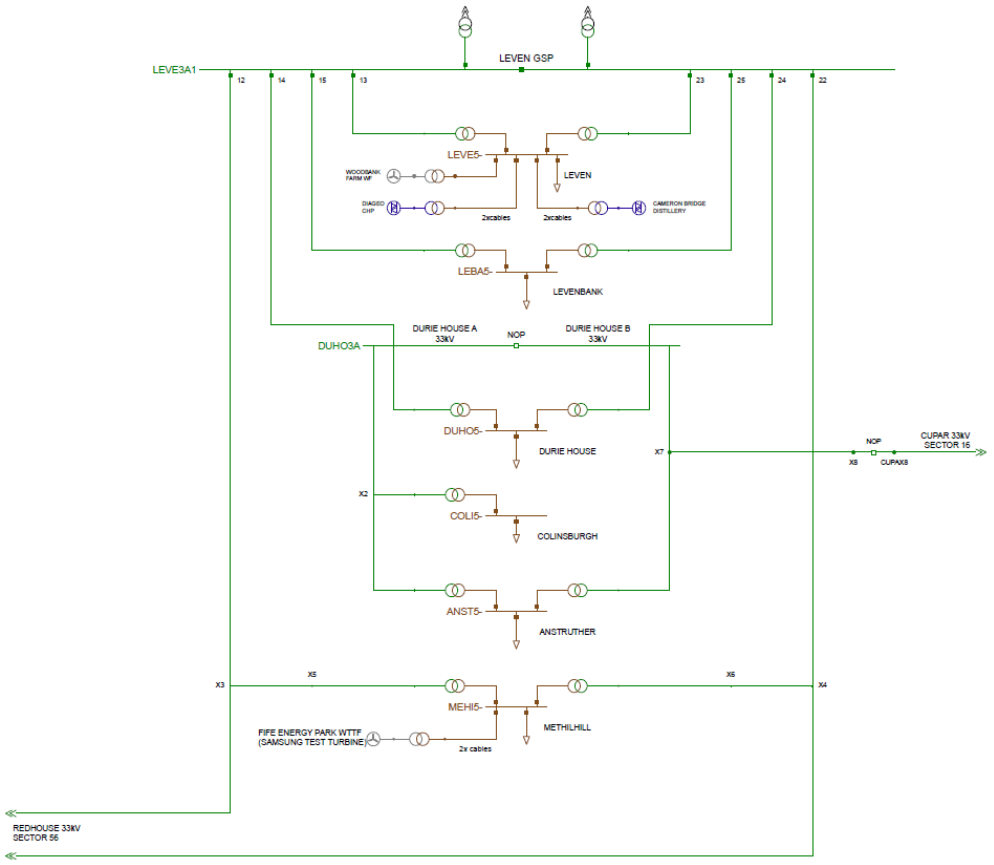

Figure 2. Existing 33kV Network

2.2 Group Demand & Security of Supply

Historically, the group demand at Levenbank primary has approached, or exceed, the firm capacity of the group. The existing group demand is shown in Table 2-1. Levenbank demand group is a class 'B' of supply as per ENA Engineering Recommendation (EREC) P2/7.

Table 2-1. Levenbank primary group demand (2020 Load Index)

Demand Group	Customers (#)	Firm Capacity (MVA)	Max Demand (MVA)	Load Index	P2/7 Class of Supply
Levenbank	3,417	10	10.2	LI4	B

Levenbank Primary is fed via two 33kV UGC circuits. The minimum rated section of the circuit has a summer/winter cyclic (ducted) thermal rating of 20.8/21.61 MVA. The group is served by two 10MVA, Bonar Logan M21 AX 4T, 33/11kV transformers (1958). A summary of the transformer data is presented in Table 2-2.

Table 2-2. Levenbank primary transformer data

	T1	T2
Manufacturer	Bonar Logan, M21 AX 4T	Bonar Logan, M21 AX 4T
Manufacturer Year	1958	1958
Voltage	33/11kV	33/11kV
Thermal Rating	10MVA	10MVA
Health Index	5	5

Based on historic measured data, this area of network would be unable to accommodate any sustained growth without exceeding the 10MVA firm capacity of the group.

2.3 Embedded Generation

Levenbank primary currently has total of 0.79MW of small (<1MW) embedded generation connected to the network.

2.4 Fault Levels

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

3 Needs Case

Our Baseline View forecasts a peak demand of 11MVA by 2028, including an expected uptake of up to 369 electric vehicles and 612 heat pumps. This exceeds the 10MVA firm capacity of Levenbank primary demand group by the end of RIIO-ED2.

The present level of utilisation at Levenbank constrains routine operational activities. For example, there are now limited opportunities to transfer demand from Durie House Primary during periods of high demand or for planned outages.

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 is depicted in Figure 3. The anticipated total electric vehicle and heat pump uptakes based on the future energy scenarios are depicted in Figure 4.

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.

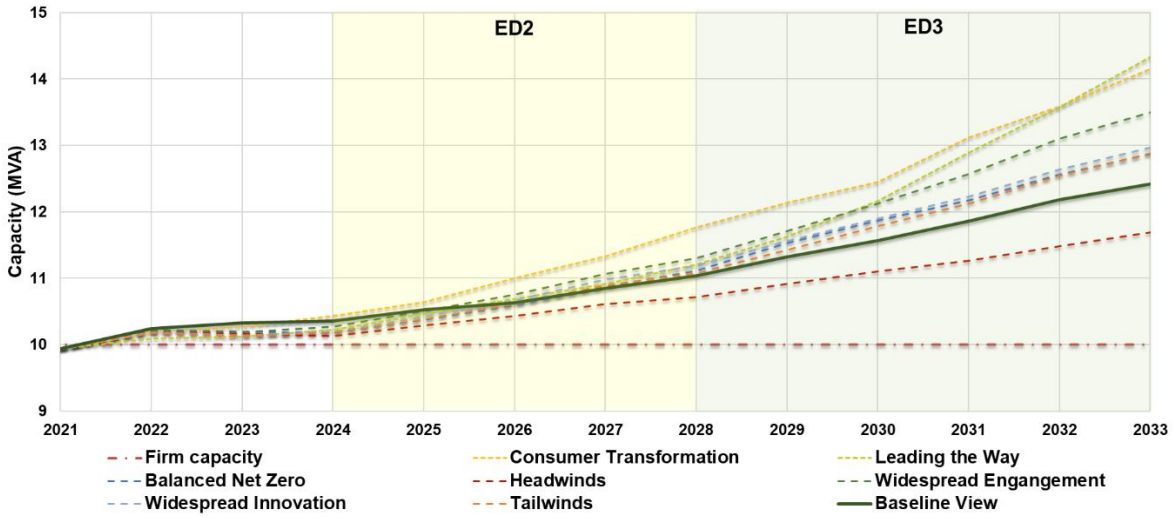

Figure 3. Demand (MVA) forecast for Levenbank demand group

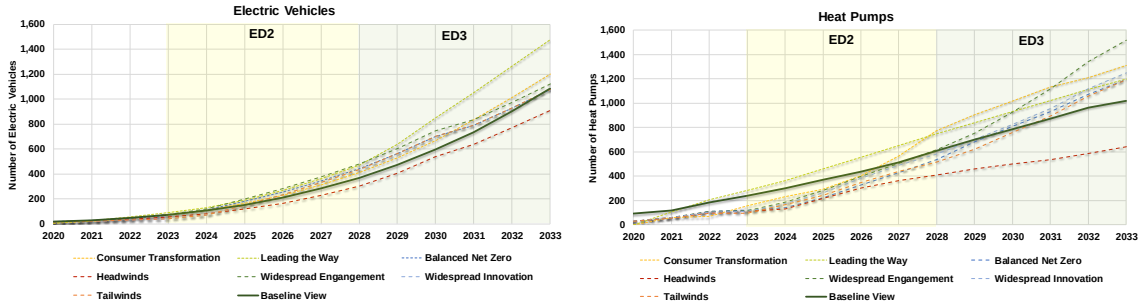

Figure 4. Forecast Electric Vehicle and Heat Pump uptakes for Levenbank demand group

3.1.2 Baseline View

For the Levenbank group demand, this forecast demand growth under our Baseline scenario, along with the firm capacity and utilisation through to the end of the RIIO-ED3 period is shown in Table 3-1.

Table 3-1. Baseline View forecast

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Forecast Demand (MVA)	9.94	10.2	10.3	10.4	10.5	10.6	10.8	11.0	11.3	11.6	11.9	12.2	12.4
Firm Capacity (MVA)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Utilisation (%)	102	102	103	104	105	106	108	110	113	116	119	122	124
Load Index	LI4	LI4	LI4	LI5	LI5	LI5	LI5	LI5	LI5	LI5	LI5	LI5	LI5

3.2 Network Impact Assessment

Detailed network studies covering network intact and outage (N-1) conditions and fault level assessments were carried out for the Levenbank demand group considering the different demand forecast scenarios.

The network thermal constraint during the most onerous outage was identified and time profile-based simulations (17,520 half-hourly simulations/year) were performed considering the historical half hourly measured Supervisory control and data acquisition (SCADA) data at primary substation overlaid with the DFES demand forecasts for each year through the RIIO-ED2 price control period. These studies identify the risk in terms of the thermal capacity exceedances with the forecast demand, the anticipated annual hours at risk and risk window of the constraint. The half-hourly studies performed for years starting from 2023 through 2028 determined the risk hours and the capacity required to overcome the constraint by using flexibility services.

3.2.1 Thermal Constraints

Table 3-2 shows the identified thermal constraints on the 33/11kV network level.

Table 3-2. Thermal constraints at 33/11kV level

Network Item	Voltage	Outage
Levenbank T1	33/11kV	N-1
Levenbank T2	33/11kV	N-1

3.2.2 Voltage Constraints

There were no voltage constraints at 11kV network fed from the Levenbank primary demand group.

3.2.3 EREC P2/7 – Security of Supply

Levenbank primary substation has a forecast peak demand of 11MVA by the end of RIIO-ED2. Engineering Recommendation (EREC) P2/7 defines a group demand of 11MVA as a class 'B' of supply.

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

- Group demand minus 1MW must be met within 3 hours;
- Group demand must be met within repair time.

Levenbank group demand has an FCO security of 10MVA. Therefore, this site is predicted to be non-compliant under EREC P2/7 by the end of the RIIO-ED2 price control period; consequently, investment is required.

3.2.4 Flexibility Services

As the present level of utilisation at Levenbank constrains routine operational activities, there are now limited opportunities to transfer demand from Durie House Primary during periods of high demand or for planned outages. In order to manage the network risk on the 11kV network, our assessment indicates that the risk of thermal overload on the 33/11kV Levenbank primary transformers starts from the year 2023/24 throughout to the year 2028 for the most onerous scenario; including an additional 5% for the asset protection margin. This is shown Table 3-3. The detailed results from the half hourly profile-based simulations are furnished in Appendix 1.

Table 3-3. Network annual hours at risk and flexible capacity tendered in Spring 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	53	98	167	255	333
Required Flexible Capacity (MW)	0.63	0.87	1.11	1.42	1.66

4 Optioneering

Table 4-1 shows a summary of the options considered for this reinforcement. The baseline option represents the lowest cost conventional option, i.e. the minimum level of intervention without application of innovation.

Table 4-1. Longlist of solution options

#	Options	Status	Reason for rejection
(a)	Do nothing	Rejected	Not compliant with security of supply requirements as per EREC P2/7.
(b)	Intervention plan using only Energy Efficiency	Rejected	Discounted due to lower cost effectiveness (peak MW reduction per £) and the number of individual interventions required across the wide area supplied by this network.
(c)	BaU reinforcement strategy considers the replacement of 10MVA transformers with 20MVA units.	Shortlisted as **Baseline** option in Detailed Analysis	
(d)	BaU reinforcement strategy by establishing new primary substation.	Shortlisted as **Option 1** in Detailed Analysis	
(e)	Utilise flexibility services to defer reinforcement into RIIO-ED3	Rejected	Discounted due to insufficient flexibility capacity received for Levenbank primary to remain EREC P2/7 compliant.
(f)	Install active network management (ANM) on the 11kV network to enable dynamic transfer of demand between substations.	Rejected	Levenbank transformers are currently HI5 and would still require replacement if an ANM scheme is established. This option is not considered to offer value for money and has been discounted.
(g)	Real Time Thermal Rating (innovation).	Rejected	Levenbank transformers are currently HI5 and therefore cannot be considered for RTTR. This option is not technically viable and has been discounted.

5 Detailed Analysis & Costs

With the initial flexibility tender rounds indicating not enough response to provide with flexible capacity in the group to defer the any reinforcement scheme, hence, to address the thermal constraints in the group, a conventional build solution is proposed.

5.1 Proposed Option (Baseline) – Replace Primary Transformers

The proposed option for this scheme is to replace the existing 10MVA transformers with new 20MVA units. Table 5-1 shows the scheme summary.

Table 5-1. Proposed option summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Levenbank Primary Reinforcement	Replace 2 x 10MVA transformers with 20MVA units.	1.219	-

It is envisaged that an off-line build will be completed on undeveloped land adjacent to the existing compound. However, outages on each transformer will be required to allow for the removal of the existing transformers and to commission the new ones onto the network. An aerial view of the site is shown in Figure 5.

Figure 5. Aerial view of the site

The lowest rated 33kV circuit feeding the group is 0.3ins Cu cable with a summer/winter rating of 20.8/21.61MVA. Thus, the existing circuits feeding the group would provide sufficient thermal headroom to release the full capacity created by the transformers. A firm capacity of 20MVA would provide a 10MVA of additional thermal headroom for future load growth. Following the proposed

investment solution, Levenbank Demand Group would be EREC P2/7 compliant under all DFES scenarios.

As the existing transformers are HI5, the replacement of the existing 10MVA transformer will reduce the risk associated with Levenbank primary via the reduction of health index score for assets at the site. The proposed works would replace the existing pre-1960s transformers with modern units.

The tenders rounds from May 2021 has returned more than enough capacity for the initial two years of the RIIO-ED2 price control period, as shown in Table 5-2, with no qualifying bids for the last three years. However, it is recommended to continue annual tendering for flexibility in this area to procure capacity and the proposed conventional/build solutions will be reviewed depending on procuring enough capacity in the future tenders.

Table 5-2: Network annual hours at risk and flexible capacity tendered in May 2021

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Annual hours at risk (Hrs)	53	98	167	255	333
Required Flexible Capacity (MW)	0.63	0.87	1.11	1.42	1.66
Secured Flexible Capacity (MW)	1.4	1.8	-	-	-
Secured Flexible Capacity (%)	216%	206%	-	-	-
Cost (£m)	0.02	0.03	-	-	-

Table 5-3 shows a summary of reinforcement costs and volumes for the proposed scheme under RIIO-ED2. 33kV network configuration for the proposed option is shown in Figure 6.

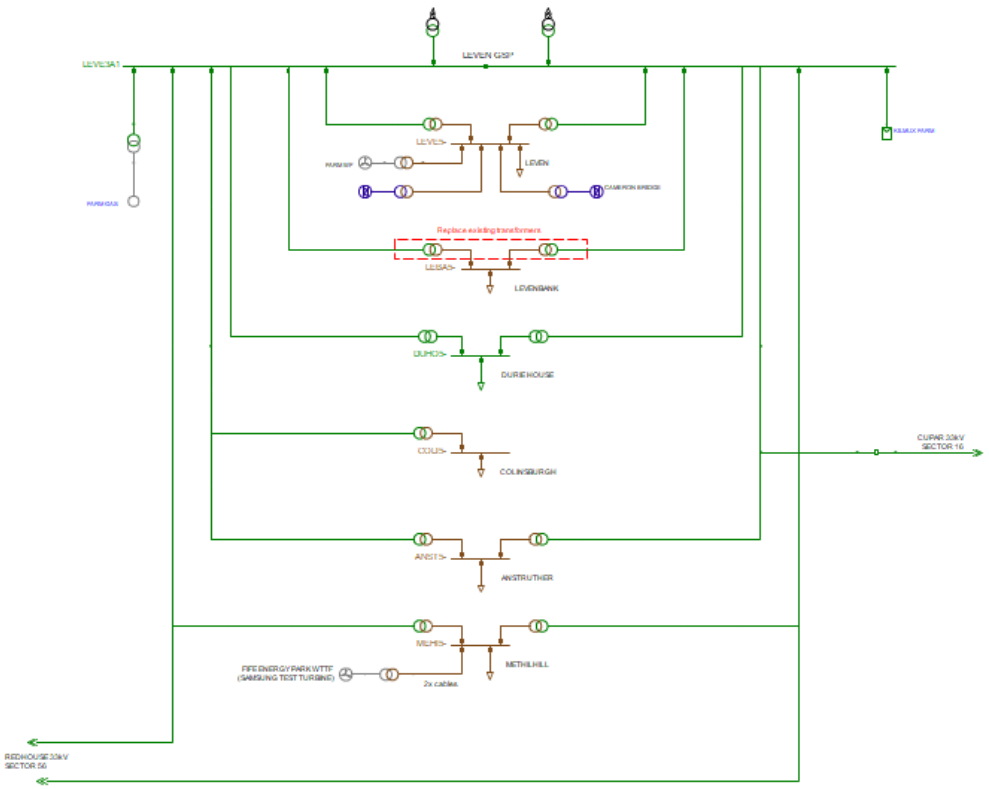

Figure 6. Schematic of the proposed option 33kV network

Table 5-3. Proposed option summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non Pressurised)	0.5	0.100	0.100	-
33kV Transformer (GM)	2	0.738	0.738	-
Pilot Wire Underground	0.5	0.055	0.055	-
Civil Works at 33 kV & 66 kV Substations		0.165	0.165	-
Wayleaves/Easements/Land Purchase		0.050	0.050	-
Other Costs (Identify Below)		0.060	0.060	-
Flexibility Services		0.050	0.050	
Total Costs		1.219	1.219	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£30k)				
Endbox replacement/fill (£30k)				

The timing of the project is based on delivering the highest NPV savings, while maintaining security of supply. The baseline view forecasts an operationally manageable level of demand during project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 10MVA released in 2024/25, upon completion of the proposed works. Flexibility services would be procured to manage the network risk through the delivery stage at a cost of £50k.

5.2 Option 1 – Establish a New Primary Substation

This option considers the establishment of a new 33/11kV 20MVA primary substation to facilitate demand growth, replacement of Levenbank HI5 Tx, like for like, under non-load and including £94k of the procurement of flexibility services to secure demand during delivery. Table 5-4 shows the scheme summary. The option would enable 10MVA additional network capacity.

The Levenbank transformers are currently HI5 and would still require replacement if a new primary substation is established. This option is not considered to offer value for money and has been discounted.

Table 5-4. Option 1 summary

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Conventional	Levenbank Primary Reinforcement	Establish new primary substation to facilitate demand growth and replace Levenbank HI5 Tx, like for like, under non-load.	5.710	-

Table 5-5 shows a summary of reinforcement costs and volumes for Option 1 under RIIO-ED2. Option 1 33kV network configuration in shown Figure 7.

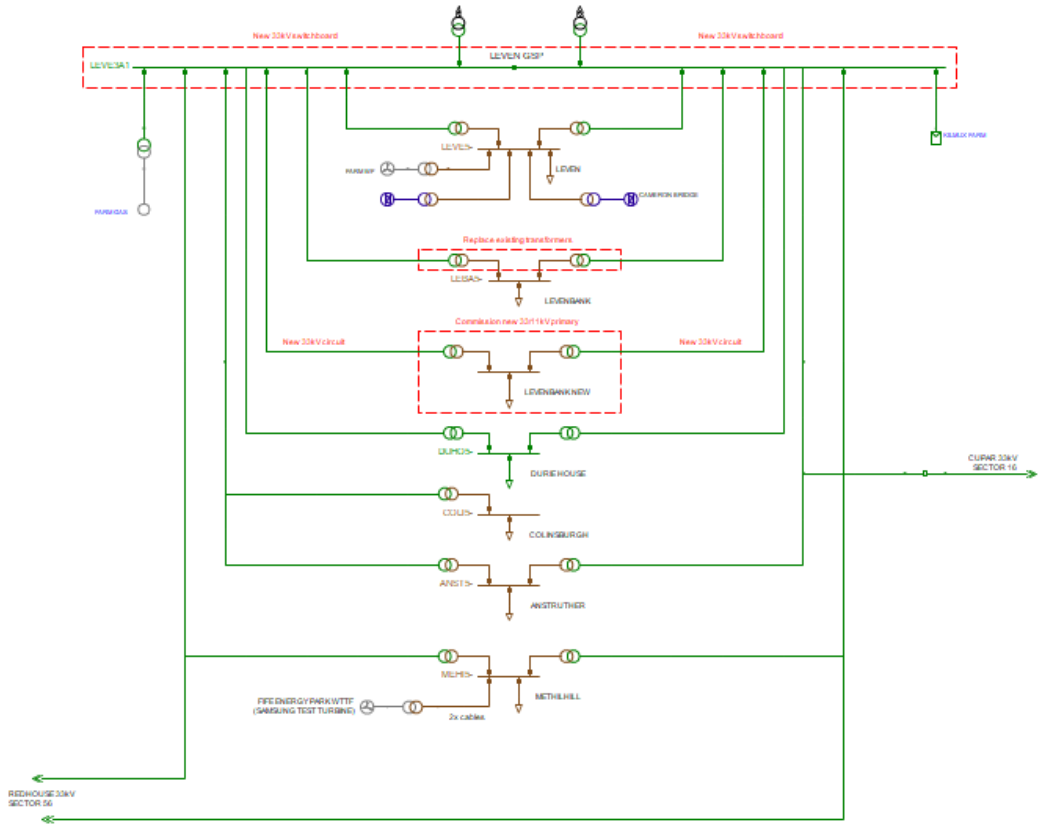

Figure 7. Schematic of Option 1 33kV network

Table 5-5. Option 1 summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
6.6/11kV OHL (Conventional Conductor)	4	0.102	0.102	-
6.6/11kV Poles	40	0.093	0.093	-
6.6/11kV CB (GM) Primary	7	0.194	0.194	-
33kV UG Cable (Non Pressurised)	0.5	0.100	0.100	-
33kV CB (Gas Insulated Busbars)(ID) (GM)	14	2.338	2.338	-
33kV Transformer (GM)	4	1.477	1.477	-
Batteries at 33kV Substations	1	0.009	0.009	-
Pilot Wire Overhead	4	0.108	0.108	-
Pilot Wire Underground	0.5	0.055	0.055	-
Civil Works at 33 kV & 66 kV Substations		0.550	0.550	-
Wayleaves/Easements/Land Purchase		0.118	0.118	-
Other Costs (Identify Below)		0.474	0.474	-
Flexibility Services		0.094	0.094	-
Total Costs		5.710	5.710	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£80k)				
Endbox replacement/fill (£30k)				
RTU/SCADA (£70k)				
Remote end protection (£294k)				

5.3 Options Cost Summary Table

Summary of the costs for each of the evaluated options is presented in Table 5-6.

Table 5-6. Cost summary for considered options

Options	Option Summary	RIIO-ED2 Cost (£m)
Baseline	Replace 10 MVA transformers with 20MVA units.	1.219
Option 1	Establish new primary substation to facilitate demand growth and replace Levenbank HI5 Tx, like for like, under non-load.	5.710

Derivation of costs for these options are based on the SPEN RIIO-ED2 Unit Cost Manual for intervention. This is based on bottom up cost assessment of the components of activity detailed within the RIGs Annex A for the above activities, SPEN's contractual rates for delivery, market available rates and historic spend levels.

6 Deliverability & Risk

6.1 Preferred Options & Output Summary

The adopted option is the baseline option to replace the existing 10MVA transformers with new 20MVA units.

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-001-CV1-CBA – Levenbank Primary Reinforcement'.

Table 6-1. Cost benefit analysis results

Options considered	Decision	Comment	NPVs based on payback periods, £m (2020/21 prices)			
			10 years	20 years	30 years	45 years
Baseline – Replace 2 x 10MVA transformers with 20MVA units	**Adopted**					
Option 1- Establish new primary substation to facilitate demand growth and replace Levenbank HI5 Tx, like for like, under non-load	Rejected	Discounted on the basis of no additional capacity uplift compared to the baseline, and higher reinforcement cost.	-2.36	-3.31	-3.87	-4.30

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 £1.219m.

Table 6-2: Summary of reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non Pressurised)	0.5	0.100	0.100	-
33kV Transformer (GM)	2	0.738	0.738	-
Pilot Wire Underground	0.5	0.055	0.055	-
Civil Works at 33 kV & 66 kV Substations		0.165	0.165	-
Wayleaves/Easements/Land Purchase		0.050	0.050	-
Other Costs (Identify Below)		0.060	0.060	-
Flexibility Services		0.050	0.050	
Total Costs		1.219	1.219	-
Identify activities included within other costs (please provide high-level detail of cost areas)				
Planning and design (£30k)				
Endbox replacement/fill (£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
CV1 (Primary reinforcement)	**1.169**	0.935	0.234	-	-	-
CV1(Flexible Services)	**0.050**	0.020	0.030			
Total Cost	**1.219**	0.955	0.264			

6.4 Risks

The main risk during delivery of this project relate to construction outages. Outages will result in load centres associated with Levenbank primary substation being on single circuit risk. It is proposed that the transformer replacement be undertaken on an off-line basis. The risk will be minimised by having suitable contingency plans for the reconnection of lost supplies in the event of loss of remaining infeed's during construction outages.

6.5 Outputs Included in RIIO-ED1 Plans

There are no outputs expected to be delivered in RIIO-ED1 that are funded within this proposal.

6.6 Future Pathways – Net Zero

6.6.1 Primary Economic Driver

The primary drivers for this investment are insufficient thermal headroom and security of supply risk. The investment does not have a strong reliance on environmental benefits.

6.6.2 Payback Periods

The CBA indicates that for the proposed option demonstrates better NPV results in all assessment periods (10, 20, 30 & 45 years) against other options. As the intervention is forecast to carry at least

a 45-year asset life expectancy, the CBA at this time justifies the intervention. Consumers will also benefit from reduced network risk immediately on completion of the project.

6.6.3 Sensitivity to Future Pathways

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

Table 6-4 shows electric vehicle and heat pump uptakes across a range of future pathways and Table 6-5 shows the sensitivity of the proposed solution and Table 6-6 shows the sensitivity of the proposed RIIO-ED2 expenditure against the full ranges of Net Zero complaint future pathways other Climate Change Committee (CCC) scenarios.

Table 6-4: Electric Vehicle and Heat Pump uptakes across a range of future pathways

End of RIIO-ED2	SPEN	DFES			CCC				
	Baseline	System Transformation*	Consumer Transformation	Leading the Way	Balanced Net Zero Pathway	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
EVs	369		411	472	443	305	482	439	439
HPs	612		776	750	539	410	620	582	517

*Note: We have excluded System Transformation from our future pathways assessment as it does not meet interim greenhouse gas emission reduction targets.

Table 6-5: Sensitivity of the proposed solution against future pathways

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

R[I] – Replacement of 2 x primary transformers
F[I] – Flexible Services

The proposed solution is robust across all range of pathways. The selected solution is not sensitive to the uptake scenario – the proposed option is selected across all scenarios. The scope of works of the solution are robust across all pathways. The proposed option is expected to endure beyond RIIO-ED3 in all cases. The timing of the requirement is found to be slightly sensitive to uptake rates but is found to be required under all scenarios within the RIIO-ED2 period.

Table 6-6: Sensitivity of the proposed RIIO-ED2 expenditure

	Baseline	Uncertain
RIIO-ED2 Expenditure (£m)	1.219	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 262 tonnes. The monetised embodied carbon value associated with this emission is £11.8k. 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 Levenbank Primary Reinforcement programme has the potential to impact on SPEN's Business Carbon Footprint (BCF) and on the embodied carbon resulting from the delivery of the programme.

Upfront costs associated with resized assets used within the reinforcement programme (e.g. embodied carbon in the materials and emissions associated with civil engineering works) will be considered against the potential operational efficiency improvements associated with the new assets from a lifetime carbon perspective. For example, with the carbon emissions resulting from the raw materials

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

and manufacture of a new transformer only contributing around 5-10% of its whole-life carbon impact, 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 an EHV 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 associated of the Levenbank Primary Reinforcement programme, we need access to reliable data from our suppliers. The need for carbon and other sustainability credentials to be provided now forms part of our wider sustainable procurement policy.

We believe that such a requirement sends a strong message to our suppliers that we take sustainability seriously, and that such positive engagement is key to improving the overall sustainability of our collective supply chain.

6.7.3 Resource Use and Waste

The Levenbank Primary 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 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 Levenbank Primary Reinforcement programme will only affect a single named 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 but recognises that the nature of our substations makes it challenging to minimise their visual impact.

6.7.7 Climate Change Resilience

In addition to our efforts to minimise our direct carbon emissions in line with our Net Zero ambitions, we are also conscious of the need to secure the resilience of our assets and networks in the face of a changing climate. We have also modified our policy on vegetation control in the face of higher temperatures and longer growing seasons.

7 Conclusion

Levenbank 33/11kV primary group is geographically located in the Central & Fife region of SP Distribution licence area. The group supplies Leven town and currently serves ca. 3,417 customers. Historically, the group demand at Levenbank primary has approached, or exceed, the 10MVA firm capacity of the group. The Distribution Future Energy Scenarios forecasts a peak demand of 11.0MVA by 2028, with an expected uptake of up to 369 electric vehicles and 612 heat pumps by the end of the RIIO-ED2 period.

In order to secure supplies within the group, meet the licence obligations under EREC P2/7 – Security of Supply and to accommodate future demand growth within the area, it is proposed to carry out system reinforcement in the RIIO-ED2 price control period.

The proposed scheme is the baseline option of replacement of the Levenbank 10MVA transformers with 20MVA rated units and procure flexibility services to manage the network risk through the delivery stage at a cost of £50k. It is recommended to continue annual tendering for flexibility in this area to procure enough capacity and review the proposed conventional/build solutions or in the likely case of additional demand uptake in the group.

The estimated cost for the above is £1.219m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

The timing of the project is based on delivering the highest NPV savings, while maintaining security of supply. The baseline view forecasts an operationally manageable level of demand during project delivery; with the level of difficulty, in managing the constraint, increasing throughout RIIO-ED2. For that reason, it is proposed to start the works at the beginning of RIIO-ED2, in 2023/24, with a capacity of 10MVA released in 2024/25, upon completion of the proposed works.

8 Appendices

Appendix 1. System Study Results

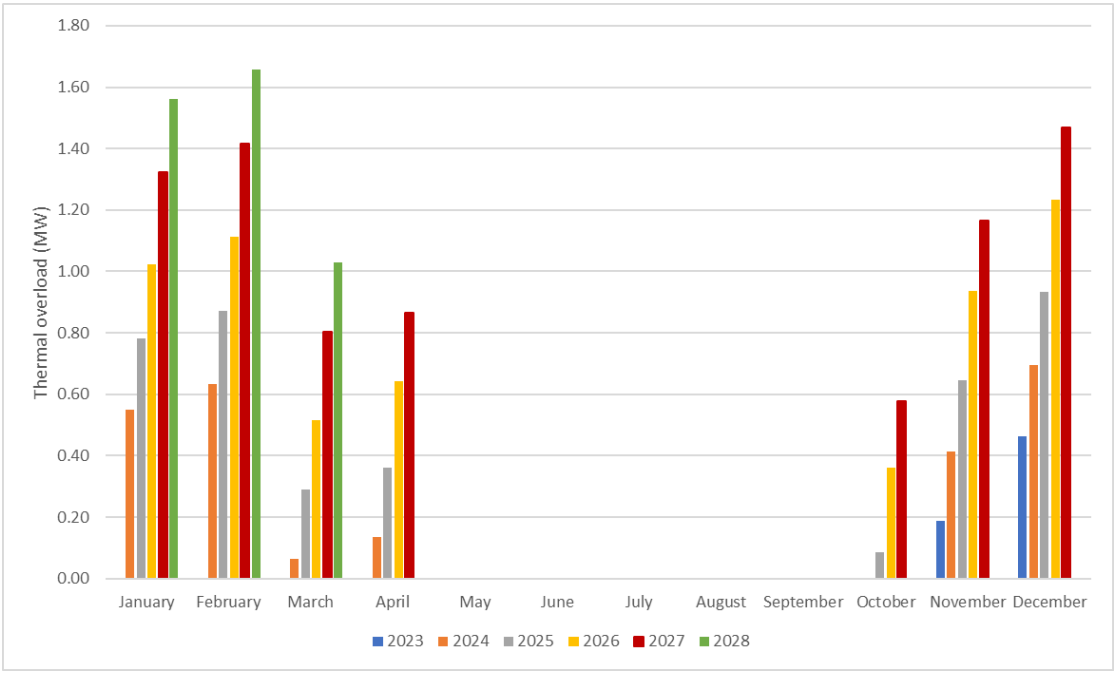

Figure 8. Monthly maximum overload on 33/11kV Levenbank transformer