Formby – Southport 33kV Reinforcement

ED2 Engineering Justification Paper

ED2-LRE-SPM-012-CV1-EJP

Issue	Date	Comments
Issue 0.1	Jan 2021	Issue to SRG and external assurance
Issue 0.2	Apr 2021	Reflecting comments from SRG
Issue 0.3	May 2021	Reflecting assurance feedback
Issue 1.0	Jun 2021	Draft Business Plan Submission
Issue 1.1	Oct-21	Reflecting updated DFES forecasts
Issue 1.2	Nov-21	Reflecting updated CBA results
Issue 2.0	Dec-21	Final Business Plan Submission

Scheme Name	Formby – Southport 33kV Reinforcement		
Activity	33kV Network Reinforcement		
Primary Investment Driver	Thermal Constraints		
Reference	ED2-LRE-SPM-012-CV1-EJP		
Output Type	Load Index		
Cost	£6.323m		
Delivery Year	2024-2026		
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**
	-	**£6.323m**	**-**

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:	Formby – Southport 33kV Reinforcement
Project Reference:	ED2-LRE-SPM-012-CV1-EJP
Decision Required:	To give concept approval for the installation of a new 33kV interconnector circuit between Formby and Southport Grid substations.

Summary of Business Need:

Formby - Southport 33kV grid group is located within the Kirkby 132kV GSP group and provides supplies to 44,750 customers across the Sefton coastal regions of Ainsdale, Birkdale, Formby and Southport.

Based on the SPM Distribution Future Energy Scenarios the demand growth in this group is expected to exceed network capacity during the ED2 period. This area is forecast to have ca. 10,189 electrical vehicles and 3,819 heat pumps by the end of ED2.

Detailed network studies involving all N-1 / N-1-1 outages have identified a thermal constraint on the two outgoing circuits from Formby Grid substation due to thermally limiting overhead line sections, one of which runs across the environmentally sensitive Sefton coast.

Half-hourly time-profile studies have been undertaken to quantify the hours at risk and flexibility services required to manage the constraint. A total of 14.3MW of Secure product requirement was issued for tender to over the ED2 period, the responses returned were insufficient to manage the thermal constraints and as such requires an intervention in the ED2 period.

The primary driver for the proposed investment is to mitigate the thermal constraints in the Formby – Southport 33kV group. The proposed solution is to install a new ca 14km 33kV interconnector circuit between Formby and Southport Grid substations, providing an additional headroom of 28MVA and addresses the thermal overloads in the group.

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

Proposed works at 33kV:

1. Install a new 400 sq. mm AL XLPE 33kV interconnector cable circuit between Formby and Southport Grid substations along with ducts and fibre comms and protection upgrades.
2. Extend the 33kV switchboard at Formby Grid substation by one circuit breaker; refurbish and use an existing spare circuit breaker at Southport Grid substation.
3. Procure flexible services through the project delivery to manage the network risk.

The estimated cost for the above is **£6.323m** (in 2020/21 prices) with 100% contribution to be included in the ED2 load related expenditure. This proposed option will provide an additional headroom of 28MVA in the Formby-Southport 33kV grid group.

Expenditure Forecast (in 2020/21 Prices)

Licence Area	Reporting Table	Description	Total (£m)	Incidence (£m)				
				2023/24	2024/25	2025/26	2026/27	2027/28
SPM	CV1	Primary Reinforcement	**6.286**	2.095	2.095	2.095	-	-
SPM	CV1	Flexible Services	**0.037**	0.008	0.012	0.018	-	-
		Total	**6.323**	2.103	2.107	2.113		

PART B – PROJECT SUBMISSION

Proposed by	Ramesh Pampana	Signature	P. Ramesh	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

Formby - Southport 33kV grid group is located within the Kirkby 132kV GSP group and provides supplies to 44,750 customers across the Sefton coastal regions of Ainsdale, Birkdale, Formby, and Southport.

The SP Manweb(SPM) Distribution Future Energy Scenarios have forecast 77MVA of demand and LCT uptake in the form of Electric Vehicles and Heat Pumps of up to 10,189 and 3,819 respectively by 2028, under the Baseline scenario in the group, one of the highest concentrations of LCT uptake is SPM license area due to the affluent demographic in the area. Network studies have indicated that the group is constrained in meeting the forecast demand growth, the thermal constraints are due to the limited capacity of the overhead line and underground cable sections, particularly those emanating from Formby Grid substation.

The primary driver for the proposed investment is to mitigate the thermal constraints in the Formby – Southport 33kV group. In order, to secure supplies within the group as per EREC P2/7 Security of Supply, to meet the licence obligation to develop and maintaining economic, efficient and coordinated network for the distribution of electricity, to accommodate future demand growth within the area, it is proposed to mitigate the thermal constraints in the grid group by installing a new 33kV interconnector cable circuit. .

Summary of the proposed scheme:

1. New 33kV, 14km long, 400 sq. mm XLPE AL UGC circuit between Formby and Southport Grid substations, along with ducts and fibre comms and protection upgrades.
2. New 33kV indoor circuit breaker (requires board extension) at Formby Grid; Refurbish and use an existing spare circuit breaker at Southport Grid substation.
3. Procure flexible services through the project delivery to manage the network risk.

Total scheme cost – £6.323m (2020/21 prices), of which £6.286m is the scheme cost and £37k is for flexible services to manage the risk during the scheme delivery, fully funded by SPEN under CV1 (primary Reinforcement) category in the RIIO-ED2 period. The works for the scheme are proposed to begin at the start of ED2 and aimed to be delivered by 2025/26 sufficiently intime to manage the thermal constraints built-up; a thermal headroom uplift of 28MVA will be claimed upon the completion.

2 Background Information

2.1 Existing / Authorised Network

Formby - Southport 33kV grid group is supplied from the Kirkby 132kV GSP by 2 x 60MVA grid transformers at Southport and 1 x 60 MVA grid transformer at Formby and is normally operated split from the adjacent Aintree-Formby-Litherland 33kV group at Formb**y** as shown in Figure **2-1.**

The group's circuit topology is a mix of both overhead lines (OHL) and underground cables (UGC) as shown in shown in Figure **2-2**; all the OHL circuits are of 0.15 sq.in copper conductor type strung on wooden poles, these OHL sections have summer Intact / First Circuit Outage(FCO) ratings of 17.66MVA / 20MVA correspondingly. The two circuits emanating from Formby Grid going to Dover Rd & Pinfold as well as the Southport Grid – Grantham Close – Pinfold Lane circuits have these thermally limiting 0.15 sq.in Cu, wooden pole sections. Further, the Formby Grid- Dover Road circuit runs along the Sefton Coast, a designated Special Area of Conservation (SAC)[1] and also the OHL sections of the circuit runs along the railway line as indicated in Figure 2-2.

[1] https://sac.jncc.gov.uk/site/UK0013076

The 33kV group supplies to the underlying 5 HV groups as listed below in Table 2-1. The Banastre Road / Dover Road / Grantham Close 6.6kV primary group is currently operated with one primary transformer on open standby due to fault level issues. This group is currently being uprated to 11kV, this will resolve the fault level issues and increase the future firm capacity to 20MVA.

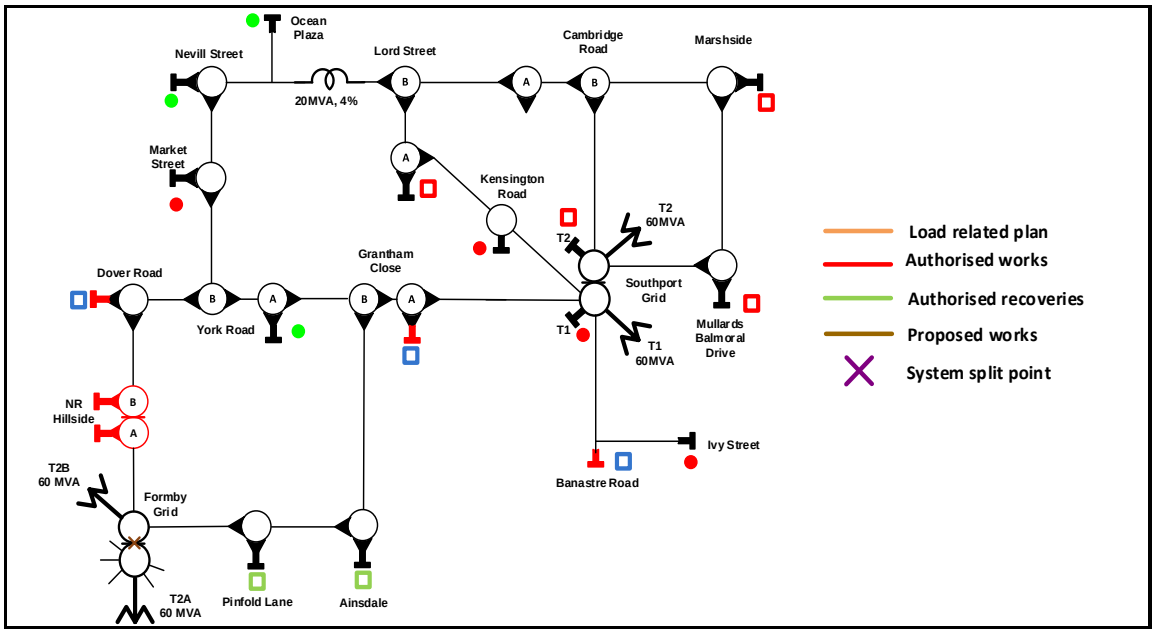

Figure 2-1: Formby – Southport 33kV grid group schematic

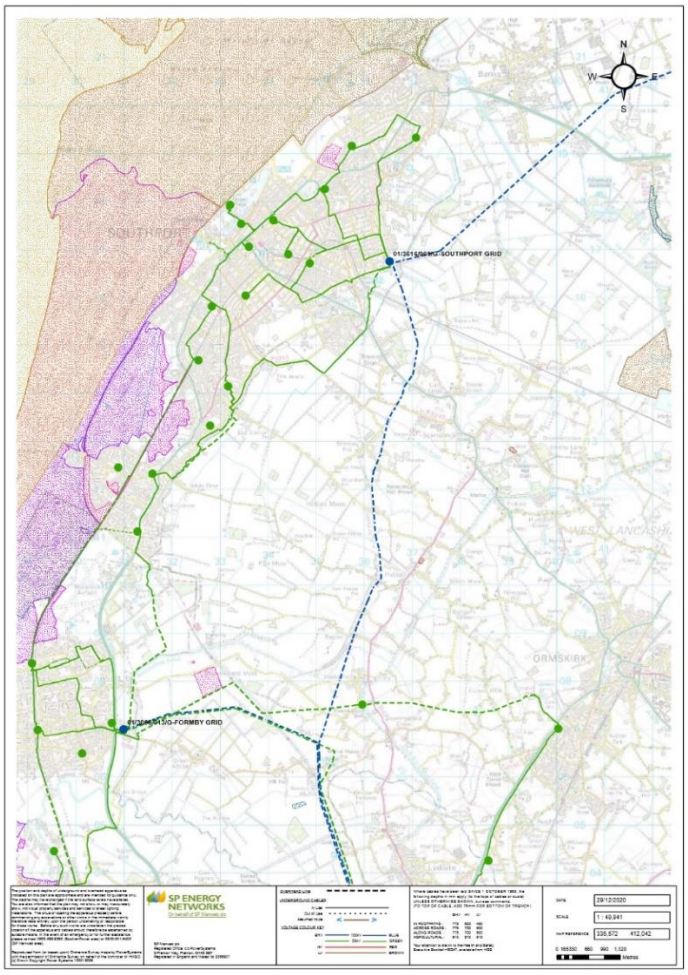

Figure 2-2: Formby – Southport 33kV grid group and primary substation locations

Table 2-1: Formby – Southport Demand groups

Demand Group	Voltage (kV)	LI max demand (MVA)	Firm Capacity (MVA)	Outage Condition	Class of Supply	LI ranking	Customers (#)
Ainsdale / Pinfold Lane	6.6	7.2	9.1	N-1	B	LI1	4,672
Banastre Road / Dover Road / Grantham Close	6.6	11.7	9.1	N-1	C	LI5	8,860
Ivy Street (Southport) / Kensington Road / Market Street / Southport	11	14.7	30	N-1	C	LI1	9,448
Lord Street / Marshside / Mullards Balmoral Drive / Southport	11	20.7	30	N-1	C	LI1	16,113
Nevill Street / Ocean Plaza / York Road	11	9.9	20	N-1	C	LI1	5,658
Formby - Southport	33	34.90	40	N-1-1	D	LI4	44,750
		64.55	75	N-1			

2.2 Group Demand & Security of Supply

The measured demand of the group is 65.5MVA (Winter peak), 38MVA (Summer peak). The aggregated capacity from the underlying distributed generation is less than the 5% of the measured demand and hence the group demand is same as the measured demand which is 64.5MVA. As per EREC P2/7, the group is categorised as Class 'D' and requires N-2 redundancy at 132kV level to meet the demand.

With the 3 x 60 MVA grid transformers supplying the group, it is secured for first circuit outages (N-1 outages); however for the loss of both Southport Grid transformers (N-1-1 outages), the group is just supplied off the single infeed from Formby Grid transformer GT2B and is limited by OHL section ratings of the two outgoing interconnecting circuits from Formby Grid to Dover Road and Pinfold Lane. This also limits utilising the full capacity of the 60MVA Formby Grid transformer, as the combined capacity of these two circuits only adds up to 40MVA (Summer) / 45.63 MVA (Winter).

An additional demand of 4MVA is due for connection in 2021, no other 33kV generation is connected/ contracted in the group.

2.3 Thermal overloads

For the existing network, system studies have identified thermal overloads in the group. The outage conditions under which the circuit loadings are approaching / exceeding the circuit ratings are listed below,

- For either loss of Formby-Hillside or Formby-Pinfold Ln, the other circuit is loaded up to 95% of OHL's 20MVA FCO rating in Summer and 90% of the UGC's 22.63MVA cyclic rating in winter maximum demand conditions correspondingly.
- For the loss of Southport Grid transformer GT2 both Formby-Hillside and Formby-Pinfold Lane circuits are loaded up to 89% of OHL's 20MVA FCO rating in Summer and 86% of the UGC's 22.63MVA cyclic rating in winter maximum demand conditions correspondingly.
- For the loss of both Southport Grid transformers GT1 & GT2 (N-1-1) , the group is supplied from single infeed of Formby Grid transformer GT2B, this results in the circuit loading approaching protection limits of 150% of intact ratings under summer and winter maximum demand conditions.

2.4 Fault levels

There are no other fault level issues in the group.

3 Needs Case

The Formby-Hillside and Formby-Pinfold Lane circuits are critical in the group as these two are the only outgoing circuits from Formby Grid (compared to the 5 outgoing circuits from the Southport Grid) and both circuits are thermally limited by the 0.15 sq. in HDC wooden pole OHL sections and 185 sq. mm PILC HSL cable sections. The disaggregation of circuit sections in terms of conductor type, construction, ratings and lengths is shown in Table 3-1.

The existing thermal overloads in the group are highlighted in the section 2.3. With the forecasted demand growth, the existing thermal overloads are exacerbated, and the group is further thermally constrained for the loss of first and second circuit outages (N-1 / N-1-1). To address the identified thermal overloads and to create further headroom in the group, it is required to reinforce the group. The proposed reinforcement option and the other discounted options are discussed in Section 0.

Table 3-1: Formby circuit data

Circuit	Section (#)	Conductor Type	MVA Rating (Cont. / Cyclic)		Length (km)
			Summer	Winter	
Formby - Pinfold Lane	1	**Cu, 0.15 WPole, OHL**	**17.66 / 20.01**	**22.01 / 24.98**	**3.07**
	2	Al, 0.5 PILC HSL, UGC	20.92 / 22.38	21.95 / 23.48	0.69
	3	Cu, 185 PILC HSL, UGC	20.12 / 21.53	21.15 / 22.63	0.67
	4	Cu, 0.3 PILC HSL, UGC	20.46 / 21.89	21.49 / 23.0	0.60
				Total Length	**5.03**
Formby - Hillside	1	Al, 0.5 PILC HSL, UGC	21.9 / 24.7	22.78 / 25.69	4.10
	2	**Cu, 0.15 WPole, OHL**	**17.66 / 20.01**	**22.01 / 24.98**	**3.04**
	3	Cu, 0.3 UNKNOWN, UGC	20.46 / 21.89	21.49 / 23.0	2.06
	4	**Cu, 0.15 WPole, OHL**	**17.66 / 20.01**	**22.01 / 24.98**	**0.43**
	5	Cu, 0.4 PILC HSL, UGC	23.66 / 27.66	24.85 / 29.03	0.25
	6	Cu, 0.3 PILC HSL, UGC	20.9 / 23.6	21.74 / 24.54	0.03
				Total Length	**9.90**

3.1 Forecast Demand

The peak demand observed in the group is 64.5MVA (Winter). The system is forecast to grow and exceed firm capacity within the ED2 period. This forecast is based on actual system measurement data from the PI system and stakeholder endorsed Distribution Future Energy Scenarios (DFES) and considers the known pipeline of developments in the group.

3.1.1 Distribution Future Energy Scenarios

The DFES includes granular forecasts to 2050 for demand, generation and Low Carbon Technologies. They assess four 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 summer and winter demand forecast based on the SPM Distribution Future Energy Scenarios, including authorised connections are depicted in Figure 3-1.The group has one contracted connection of 4MVA at Hillside primary substation, due for connection in 2021. The anticipated total electric vehicle and heat pump uptake based on the future energy scenarios is depicted in Figure 3-2.

Based on the Baseline scenario, uptake of up to 10,189 electrical vehicles and 3,819 heat pumps and the peak demand is forecast to be 77MVA by the end of ED2 period.

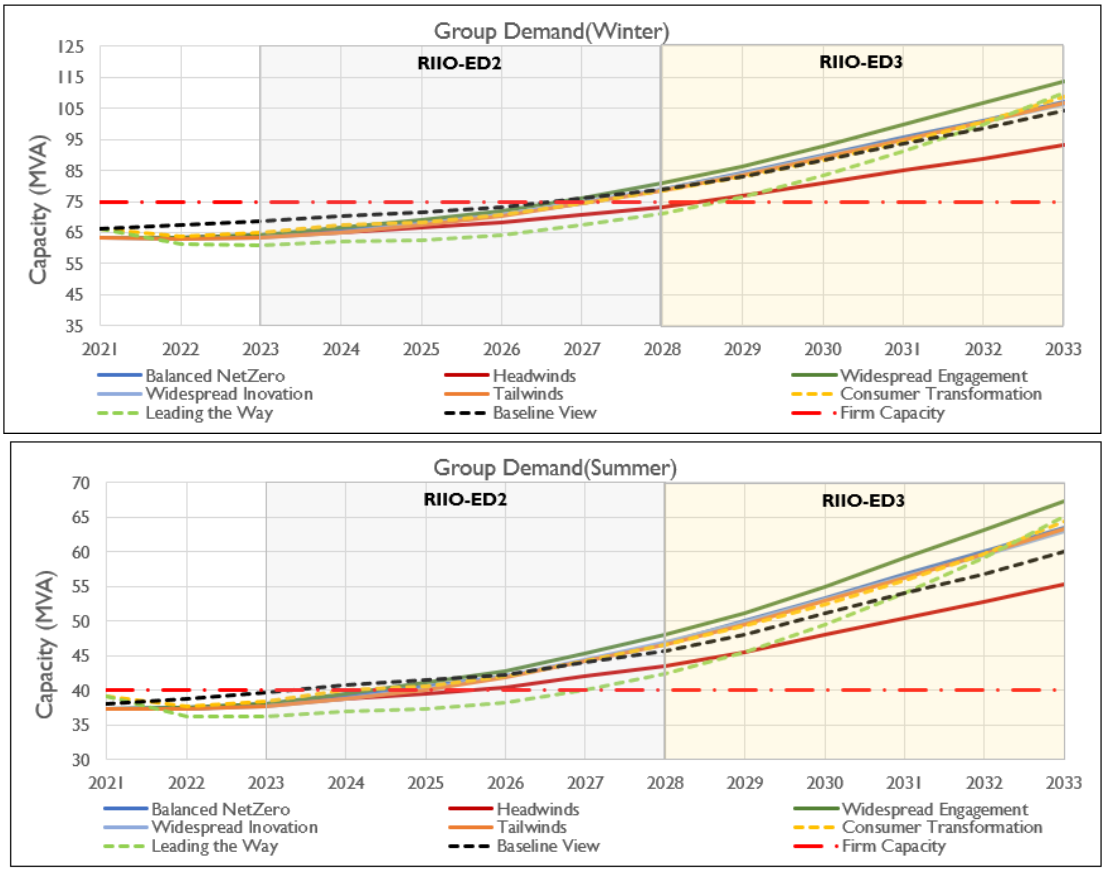

Figure 3-1: Demand (MVA) forecast for Formby - Southport group

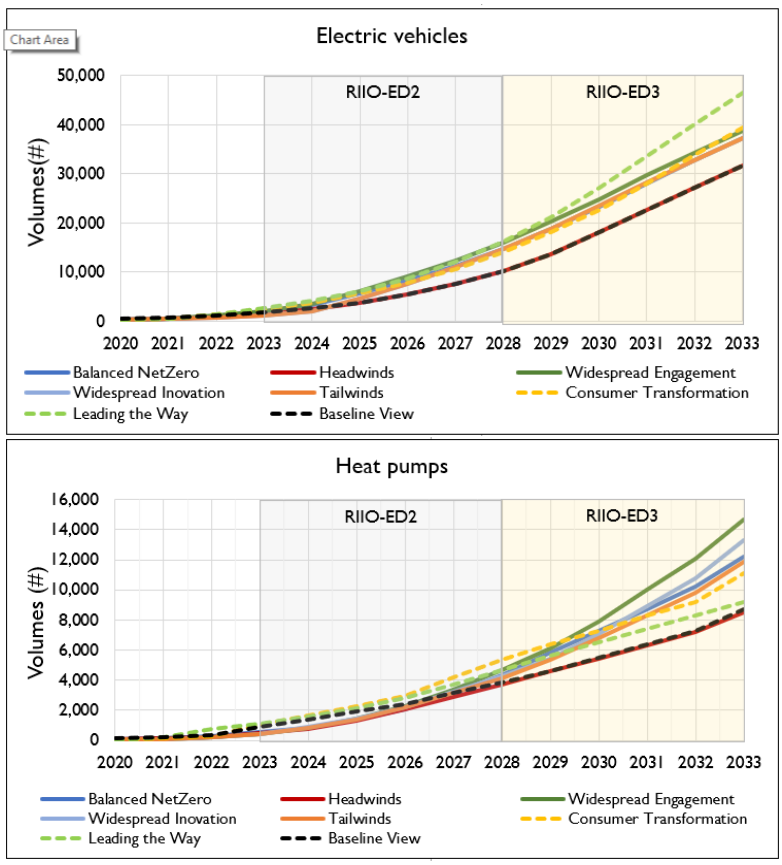

Figure 3-2: Forecasted Electric Vehicle and Heat Pump uptake

3.1.2 Baseline Scenario

For the Formby - Southport group demand, the forecast demand growth under our Baseline scenario, along with the firm capacity and utilisation through to RIIO-ED3 period is shown in Table 3-2.

Table 3-2: Baseline View forecast

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Winter													
Forecast Demand (MVA)	65	66	67	69	70	71	74	77	81	86	91	96	101
Firm Capacity (MVA)	75	75	75	75	75	75	75	75	75	75	75	75	75
Utilisation (%)	86	88	89	91	93	95	99	103	108	115	121	128	135
Load Index	LI2	LI2	LI2	LI2	LI2	LI2	LI3	LI5	LI5	LI5	LI5	LI5	LI5
Summer													
Forecast Demand (MVA)	38	39	40	41	42	42	44	46	48	51	54	57	60
Firm Capacity (MVA)	40	40	40	40	40	40	40	40	40	40	40	40	40
Utilisation (%)	95	97	99	102	104	106	110	114	120	128	135	142	150
Load Index	LI2	LI2	LI2	LI2	LI2	LI2	LI3	LI5	LI5	LI5	LI5	LI5	LI5

3.2 Network Assessments

Detailed network studies covering network intact and outage (N-1 / N-1-1) conditions and fault level assessments were carried out for 33kV network group fed from the Kirkby GSP 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 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 potential risk duration and risk window of the constraint, help in determine the risk hours and the capacity required to overcome the constraint, using flexible services.

3.2.1 Thermal Constraints

Network studies highlight the following issues under outages scenarios:

1. For the planned/ unplanned loss of either Formby – Hillside or Formby – Pinfold Lane circuits, under winter max demand conditions, the other circuit exceeds 102% of the UGC's 22.63MVA summer FCO rating and 100% of UGC's 24.48MVA cyclic rating correspondingly.
2. For the planned/ unplanned loss of either Formby – Hillside or Formby – Pinfold Lane circuits, under summer max demand conditions, the other circuit exceeds 100% of the OHL's 20MVA summer FCO rating and 100% of UGC's 22.63MVA cyclic rating correspondingly.
3. For the loss of Southport Grid transformer GT2 both Formby-Hillside and Formby-Pinfold Lane circuits are loaded under summer max demand conditions, the other circuit exceeds 96% of the OHL's 20MVA summer FCO rating and 98% of UGC's 22.63MVA cyclic rating.
4. For the loss of the two Southport Grid transformers(planned outage followed by a forced outage), under summer max demand conditions, both the Formby – Hillside and Formby – Pinfold Lane circuits exceed the OHL's summer cyclic rating of 20MVA; the thermal overloads approaching the protection setting of 150%.

Table 3-3 shows the identified thermal constraints on the 33kV groups.

Table 3-3: Thermal constrained circuits

Network Item	Voltage (kV)	Outage
Formby – Hillside circuit	33	N-1 / N-1-1
Formby – Pinfold Lane circuit	33	N-1 / N-1-1

3.2.2 Voltage Constraints

No other voltage constraints observed in the group under intact or outage conditions.

3.2.3 EREC P 2/7 – Security of Supply

The current maximum group demand is 66 MVA (Winter) and 41MVA (Summer); The group demand is forecasted to increase to 77MVA by the end of ED2 (2028) and 101.38MVA by the end of ED3 (2033) under the Baseline scenario. The group's class of supply is currently is class 'D' as per EREC P2/7(≥60MW, <300MW) and continues to be the same through the ED2/ED3 periods. As such the group must be secured for a minimum of First Circuit Outage (FCO) at 33kV level and Second Circuit Outage (SCO) at the 132kV level.

Network studies indicate that Formby - Southport 33kV group is thermally constrained due to the overloads on both Formby - Hillside and Formby - Pinfold Lane circuits for FCO (N-1) on the 33kV circuits within the group and for the SCO (N-1-1) of the grid infeed transformers at Southport.

3.2.4 Fault Level Constraints

No other fault level issues in the group.

4 Optioneering

Table 4-1 shows the long list of options considered for the scheme. Few of the longlist options are rejected based on the technical and commercial rustications and the reasons are provided in the table, the rest of the options are taken forward for detail analysis and included in the cost benefit analysis. Option 1 which involves reinforcing the limiting UGC and OHL sections of both Formby circuits represents the "do minimum" scheme among the considered options.

Table 4-1: Long list of scheme options

Option	Description	Status	Reason for rejection
(a)	Do Nothing	Rejected	Rejected as the group has one of the largest uptakes in terms of LCT volumes and as such the demand is likely to exceed the groups' firm capacity in the ED2 period.
(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)	New interconnector circuit	Considered as **Baseline**	-New interconnector cable circuit from Formby to Southport, 400 sq.mm AL XLPE 14km long, along with ducts and fibre comms. -Requires board extension at Formby Grid substation; refurb and use the existing spare circuit breaker at Southport Grid substation.
(d)	Replant UGC & reconductor OHL the limiting sections on both Formby ckts	Considered as **Option 1**	-Overlay the undersized UGC section in Formby circuits with 400 sq.mm XLPE AL cable. -Reconductor the 0.15in OHL sections in the Formby circuits, with 200 sq.mm AAAC conductor.
(e)	Replant limiting UGC & new UGC replacing OHL sections on both Formby ckts	Considered as **Option 2**	-Overlay the undersized UGC section in Formby circuits with 400 sq.mm XLPE AL cable. -Underground the 0.15in OHL sections in the Formby circuits, with 400 sq.mm XLPE AL cable
(f)	Replant all the UGC/OHL sections on both Formby ckts	Considered as **Option 3**	-New 33kV 400 sq.mm XLPE AL circuits to Hillside and Pinfold Lane primary substations from Formby. - Dismantle and recover the unused OHL sections.
(g)	Use flexibility services to defer the reinforcement	Rejected	Discussed under detailed analysis.
(h)	Use RTTR on both Formby circuits	Rejected	Rejected as RTTR is unable to release sufficient capacity to manage the constraints. The thermally limiting OHL sections are likely to exceed the cyclic ratings under N-1, there isn't enough circuit headroom to manage the loading dynamically. Also, requires comms to monitor

			the loading and carries the inherent risk of tripping under comms failure.
(i)	New Grid infeed point and split the group	Rejected	Rejected as the reconfigured 33kV groups will result in 2 groups with two grid infeeds and increases the risk of security. Also, would still be constrained on the undersized OHL sections in the Formby circuits; does not help increase the group's thermal headroom also needs HV reconfiguration.

In terms of the considered options, the Baseline option introduces an additional network path in the group, alleviating the thermal overloads on the Formby circuits thereby facilitating the better utilisation of the Formby Grid transformer under outage conditions. The alternate options consider reinforcing the existing Formby circuits, involves works on the Formby - Hillside circuit which runs around the environmentally sensitive Sefton coast.

The headroom uplift provided by alternate options would be marginal compared to Baseline. Option 1, although is the 'do minimum' requirement, there is likelihood the headroom uplift will be insufficient beyond the ED2 period and might requires another intervention in the ED3 period.

5 Detailed Analysis & Costs

Network studies identified the risk in terms of the thermal capacity exceedances with the forecast demand and the anticipated duration of the risk. The studies indicate thermal overloads on the Formby-Hillside and Formby-Pinfold Lane 33kV circuits due to the under sized OHL / UGC sections The half-hourly studies performed for years starting from 2023 through 2028 helped identify the anticipated time of risk on the network as well as the flexible capacity required to alleviate the thermal overload on the network.

The studies indicate that the thermal overloads on the Formby-Hillside and Formby-Pinfold Lane circuits, the risk of potential overload starts from the year 2023/24 throughout to the year 2028 and required a max capacity of 3.61MW and a total of 14.3MW by 2028. Based on these requirements, flexible services (under Secure[2] product) were tendered in May 2021 to provide services between 2023-28 period. The tenders return after pre-qualifications bids have shown two qualified bidders, however the combined capacity from all the bidders did not meet the requested capacity any of the years between 2023-28. Table 5-1 below shows the network risk hours, the requested (tendered) capacity and the tender returns from the connected/future customers in the group.

Table 5-1: Network risk hours & flexible capacity

Year	2023/24	2024/25	2025/26	2026/27	2027/28
Risk Duration (Hrs)	36	53.5	77	136.5	291
Required Flexible Capacity (MW)	2.25	2.51	2.72	3.19	3.61
Received Flexible capacity (MW)	1.05	1.08	1.16	1.31	1.63
Flexible capacity met (%)	47%	43%	42%	41%	45%

The tender returns to-date are of insufficient capacity to manage the thermal constraints through the ED2 period without the need for a reinforcement. This proposal therefore progresses alternative options to ensure the network remains safe and secure. The flexible capacity available to the tune of 3.3MW will be utilised to support the group to manage the risk until the required reinforcement is delivered.

[2]Under Secure product the DNO procures the services ahead time to prevent the network going beyond its firm capacity.

Additionally, Flexibility tenders will be run annually/bi-annually to continue explore the market to meet the required level of flexibility in this group to mitigate the thermal issues the group and defer the reinforcement need.

5.1 Baseline – New 33kV interconnector between Formby and Southport

The proposed option for this scheme is a conventional builds solution involving a new 14km long 400 sq. mm XLPE Al interconnector cable circuit between Formby and Southport Grid substations.

Table 5-2: Proposed scheme summary and costs

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
New Circuit	Formby-Southport 33kV Reinforcement	New interconnector cable circuit from Formby to Southport Grid substations, 400 sq.mm AL XLPE 14km long, along with ducts and fibre comms.	6.323	-
		Requires board extension at Formby Grid substation.		
		Procure flexible services to mitigate network risk during scheme delivery.		

Network studies indicate that the thermal overloading of Formby-Hillside and Formby-Pinfold Lane 33kV circuits can be mitigated through reinforcing the group by installing a new interconnector UGC circuit of 400 sq.mm XLPE AL, between Formby and Southport Grid substations as indicated in Figure 5-1. The new 33kV interconnector circuit is rated for continuous/FCO of 26.5/31.1MVA (Winter) and 25.5/30MVA (Summer). The new interconnector will increase the group's Summer firm capacity to 68MVA, gives an uplift of 28MVA. The proposed new circuit route is shown in Figure 5-2. The full description of the scheme is described below,

- Install a new 33kV, 14km, 400 sq.mm XLPE AL UGC between Formby and Southport Grid substations, along new fibre comms and ducts.
- Extend the 33kV switchboard by installing a compatible circuit breaker at Formby Grid; Refurbish and use the existing spare circuit breaker at Southport Grid.
- Remote end protection changes / upgrade the existing relays with numerical ones.

The proposed scheme, will be an additional circuit path in the group, thereby increasing the group's security and create additional headroom of 28MVA in the group, can help accommodate the forecast demand growth beyond ED3. Also increases group's supply security for the loss of two Southport Grid Transformers and helps in better utilisation of the Formby Grid transformer under this scenario.

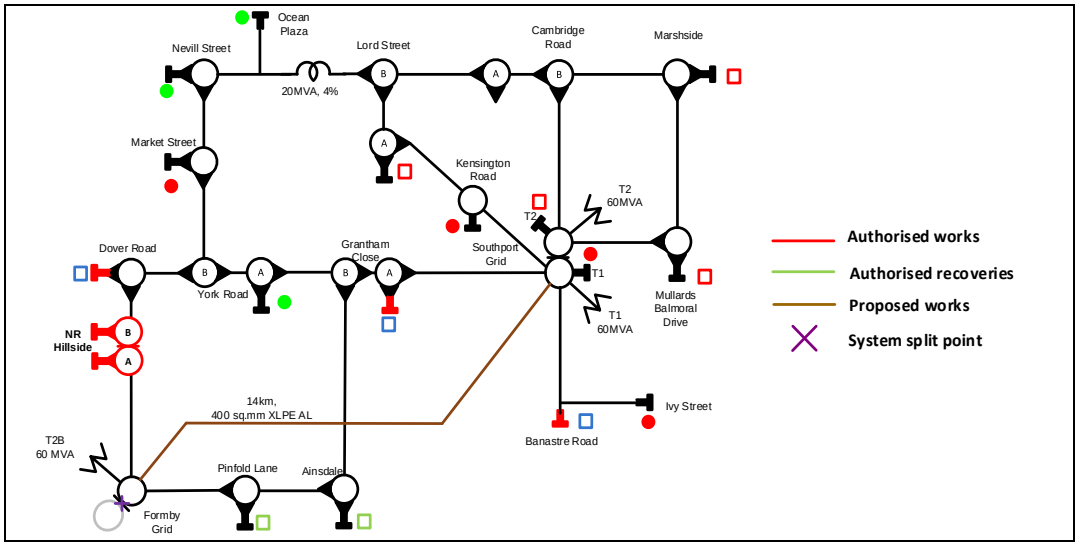

Figure 5-1: Schematic of proposed option, new interconnector between Formby and Southport

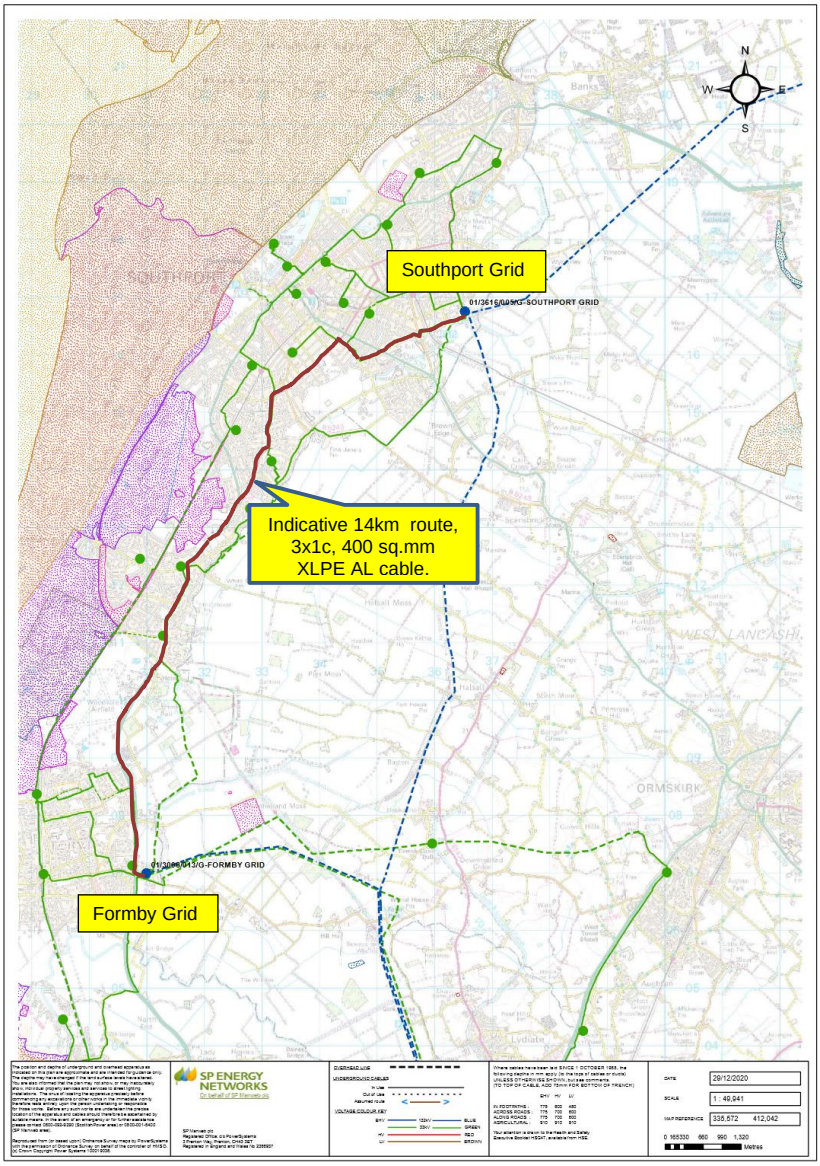

Figure 5-2: Indicative route map of the proposed interconnector

Additionally, the increase in capacity and cost of flexibility, due to demand growth, was considered against the benefit of deferral in each year of RIIO-ED2. This is assessed using flexibility to manage the constraint while the level and number of risk hours is relatively low, to commission the above proposed works when efficient to do so. The annual reinforcement deferral ceiling cost was calculated to be £260k per year to manage the constraint via flexibility. Summary of anticipated cost of flexibility services from recent round of tenders along with annual ceiling cost is shown in Table 5.3. As shown, the tender returns were insufficient across all the years in RIIO-ED2, hence the available capacity will be procured during the scheme delivery to manage the network risk. This includes a total of 3.3MW of flexibility in the RIIO-ED2 period at total cost of £0.037m

Table 5.3. Summary of flexibility service costs

Year	**2023/24**	**2024/25**	**2025/26**	**2026/27**	**2027/28**
Qualified Flexibility Services (MW)	1.05	1.08	1.16	1.31	1.63
Flexible capacity met vs required (%)	47%	43%	42%	41%	45%
Cost of Flexibility Services (£m)	0.008	0.011	0.018	-	-

5.1.1 Cost Estimates & Capital Expenditure

Table 5-4 shows the breakdown of expenditure for the proposed scheme (2020/21 prices).

Table 5-4: Reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non-Pressurised)	14.10	3.421	3.421	-
33kV CB (Gas Insulated Busbars) (ID) (GM)	1	0.170	0.170	-
Pilot Wire Underground	14	1.551	1.551	-
Civil Works at 33 kV & 66 kV Substations	-	0.037	0.037	-
Wayleaves/Easements/Land Purchase	-	0.112	0.112	-
Other Costs	-	0.500	0.500	-
Total Cost		**6.323**	**6.323**	**-**
£42k for upgrading relays/protection changes for each CB				
£40k for CB refurbishment at Southport grid substation				
£300k for traffic management on the 'A565' road				
£50k for engineering time				
£50k costs to include stakeholder engagement				
£50k for environmental and sustainability assessments				

Table 5-5: Cost Incidence over the RIIO-ED2 period

Investment category	Total	Incidence (£m)				
	(£m)	2023/24	2024/25	2025/26	2026/27	2027/28
CV1 (Primary reinforcement)	**6.286**	2.095	2.095	2.095	-	-
CV1(Flexible Services)	**0.037**	0.008	0.011	0.018	-	-
Total Cost	**6.323**	2.103	2.106	2.113	-	-

DFES forecasts indicate the firm capacity exceedances midway of RIIO-ED2. Therefore, it is proposed to start the works 2023/24 at the start of ED2, with completion in 2025/26. A capacity release of 28MVA will be claimed in 2025/26 at the end of the project.

We will continue to tender for flexible services further to procure the required capacity as well as assessing the network requirements in RIIO-ED2 with a view to defer the reinforcement if deemed economic.

5.2 Option 1: Overlay the UGC & re-conductor the OHL limiting sections

This build option involves reinforcing only the limiting OHL/UGC sections on both Formby – Hillside and Formby-Pinfold Lane circuits. The complete list of works include,

1. Formby - Hillside circuit works:
   - Overlay ca. 2.3 km long, 0.3 sq. in PILC HSL UGC sections with 400 sq.mm XLPE AL cable.
   - Reconductor ca. 3.47km, 0.15 sq.in HDC OHL sections with 200 sq. mm AAAC.
2. Formby – Pinfold Lane circuit works:
   - Overlay ca.1.96km UGC sections with 400 sq.mm XLPE AL cable.
   - Reconductor ca. 3.07km, 0.15 sq.in HDC OHL sections with 200 sq. mm AAAC.

The uplift in thermal headroom is ca. 11MVA, the Baseline scenario indicates (see Table 3-2) that the group needs intervention by 2028 in the RIIO-ED3 period. This option requires works on the OHL section (Formby - Hillside circuit) which runs through he SSSI/SCA designated conservation areas and requires extensive site surveys for the works and wayleaves from Network Rail for access to the OHL sections

Table 5-6 shows the scheme summary and costs and Table 5-7 shows the cost and volume breakdown for this option. Figure 5-3 shows the proposed works under this option.

Table 5-6: Scheme summary and costs for Option 1

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Circuit reinforcement	Formby-Southport 33kV group	**Formby - Hillside ckt:** 1. Overlay ca. 2.3 km long, 0.3 sq. in PILC HSL UGC sections with 400 sq.mm XLPE AL cable 2. Reconductor ca. 3.47km, 0.15 sq.in HDC OHL sections with 200 sq. mm AAAC. **Formby – Pinfold Lane ckt:** 1. Overlay ca.1.96km UGC sections with 400 sq.mm XLPE AL cable. 2. Reconductor ca. 3.07km, 0.15 sq.in HDC OHL sections with 200 sq. mm AAAC.	**2.031**	-

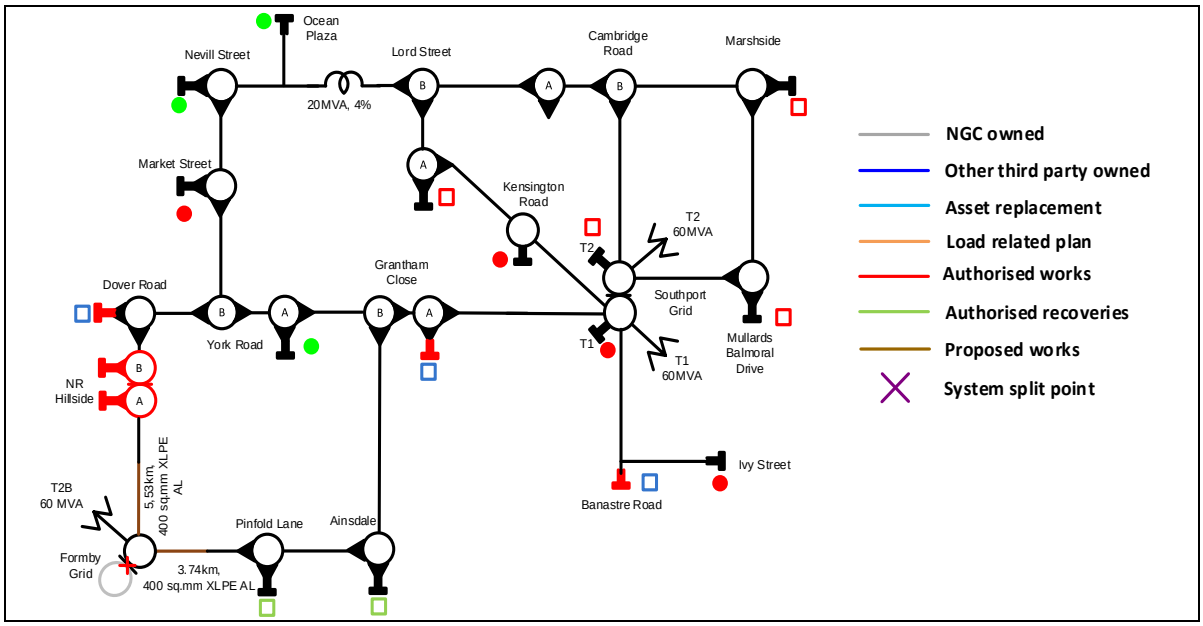

Figure 5-3: Proposed schematic of Option-1

Table 5-7: Reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV OHL (Pole Line) Conductor	6.54	0.171	0.171	-
33kV UG Cable (Non-Pressurised)	4.26	1.034	1.034	-
Pilot Wire Overhead	6.54	0.176	0.176	-
Wayleaves/Easements/Land Purchase		0.500	0.500	-
Other Costs (Identify Below)		0.150	0.150	-
Total Costs		**2.031**	**2.031**	
£100k for modern relays and protection changes				
£50k for engineering time				

5.3 Option-2: Overlay the limiting UGC & underground the OHL sections

This build option involves reinforcing the limiting UGC sections as well as replacing the OHL sections with new cable circuits and dismantling the 0.15in OHL section and recoveries. The complete list of works include,

1. Formby - Hillside circuit:
   - Overlay ca. 2.3 km long, 0.3 sq. in PILC HSL UGC sections with 400 sq.mm XLPE AL cable.

- Install new 3.47km long, 400sq. mm AL XLPE cable to replace the existing UGC sections and 0.15 sq.in OHL sections, ducts & fibre comms

2. Formby – Pinfold Lane circuit:
   - Overlay ca.1.96km UGC sections with 400 sq.mm XLPE AL cable
   - Install new ca. 3.07km long, 400sq. mm AL XLPE cable on alternate route to replace the 0.15 sq. in OHL sections, ducts, and fibre comms.

The uplift in thermal headroom is ca. 13MVA,, the Baseline scenario indicates (see Table 3-2) that the group needs intervention by 2028 in the RIIO-ED3 period. This option requires works on the OHL section (Formby - Hillside circuit) which runs through he SSSI/SCA designated conservation areas and requires extensive site surveys for the works and wayleaves from Network Rail for access to the OHL sections.

Table 5-8 shows the scheme summary and costs and Table 5-9 shows the cost and volume breakdown for this option. Figure 5-4 shows the proposed works under this option.

Table 5-8: Scheme summary and costs

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Circuit reinforcement	Formby-Southport 33kV group	**Formby - Hillside circuit**: 1. Overlay ca. 2.3 km long, 0.3 sq. in PILC HSL UGC sections with 400 sq.mm XLPE AL cable. 2. Install new 3.47km long, 400sq. mm AL XLPE cable to replace the existing UGC sections and 0.15 sq.in OHL sections, ducts & fibre comms **Formby – Pinfold Lane circuit:** 1. Overlay ca.1.96km UGC sections with 400 sq.mm XLPE AL cable 2. Install new ca. 3.07km long, 400sq. mm AL XLPE cable on alternate route to replace the 0.15 sq. in OHL sections, ducts and fibre comms. Recover the disused, 0.15 sq. in OHL sections on both circuits and 33kV poles.	**3.995**	-

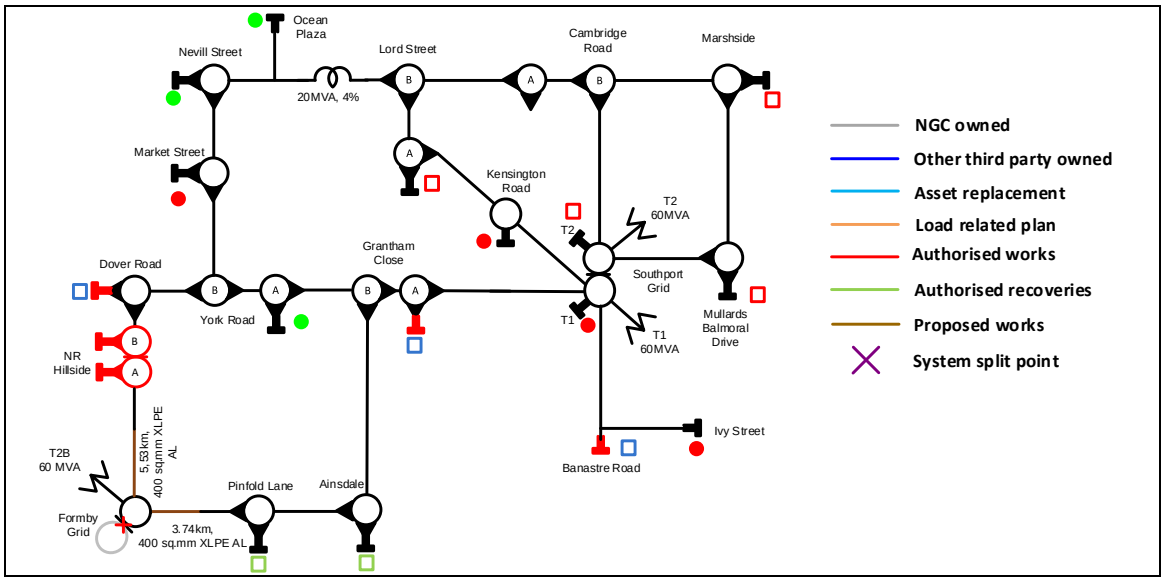

Figure 5-4: Schematic of Option-2

Table 5-9: Reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non-Pressurised)	10.80	2.620	2.620	-
Pilot Wire Underground	6.54	0.724	0.724	-
Wayleaves/Easements/Land Purchase		0.250	0.250	-
Other Costs (Identify Below)		0.400	0.400	-
Total Costs		**3.995**	**3.995**	
£250k for OHL recoveries				
£100k for modern relays and protection changes				
£50k for engineering time				

5.4 Option-3: Overlay all the UGC & underground all the OHL sections.

This build option involves reinforcing the limiting UGC sections as well as replacing the OHL sections with new cable circuits and dismantling the 0.15in OHL section and recoveries. The complete list of works include,

1. Formby - Hillside circuit:
   - Overlay ca. 6.37 km of UGC sections with 400 sq.mm XLPE AL cable.
   - Install new 3.47km long, 400sq. mm AL XLPE cable in alternate route to replace the 0.15 sq. in OHL sections, ducts & fibre comms Formby – Pinfold Lane circuit
2. Formby - Pinfold Lane circuit:
   - Overlay ca. 1.96km existing UGC sections with 400 sq.mm AL XLPE cable
   - Install new ca. 3.07km long, 400sq. mm AL XLPE cable on alternate to replace the 0.15 sq. in OHL section, ducts & fibre comms.

The uplift in thermal headroom is ca. 13MVA , the Baseline scenario indicates (see Table 3-2) that the group needs intervention by 2028 in the RIIO-ED3 period. This option requires works on the OHL section (Formby - Hillside circuit) which runs through he SSSI/SCA designated conservation areas and requires extensive site surveys for the works and also wayleaves from Network Rail for access to the OHL sections.

Table 5-10 shows the scheme summary and costs and Table 5-11 shows the cost and volume breakdown for this option. Figure 5-5 shows the proposed works under this option.

Table 5-10: Scheme summary and costs

Category	Scheme Name	Scheme Summary	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
Circuit reinforcement	Formby-Southport 33kV group	**Formby - Hillside circuit**: - 1. Overlay ca. 6.37 km of UGC sections with 400 sq.mm XLPE AL cable. 2. Install new 3.47km long, 400sq. mm AL XLPE cable in alternate route to replace the 0.15 sq. in OHL sections, ducts & fibre comms.	**4.982**	-
		Formby - Pinfold Lane circuit: 1. Overlay ca. 1.96km existing UGC sections with 400 sq.mm AL XLPE cable 2. Install new ca. 3.07km long, 400sq. mm AL XLPE cable on alternate to replace the 0.15 sq. in OHL section, ducts & fibre comms.		
		Recover the disused, 0.15sq. in OHL sections on both circuits and 33kV poles.		

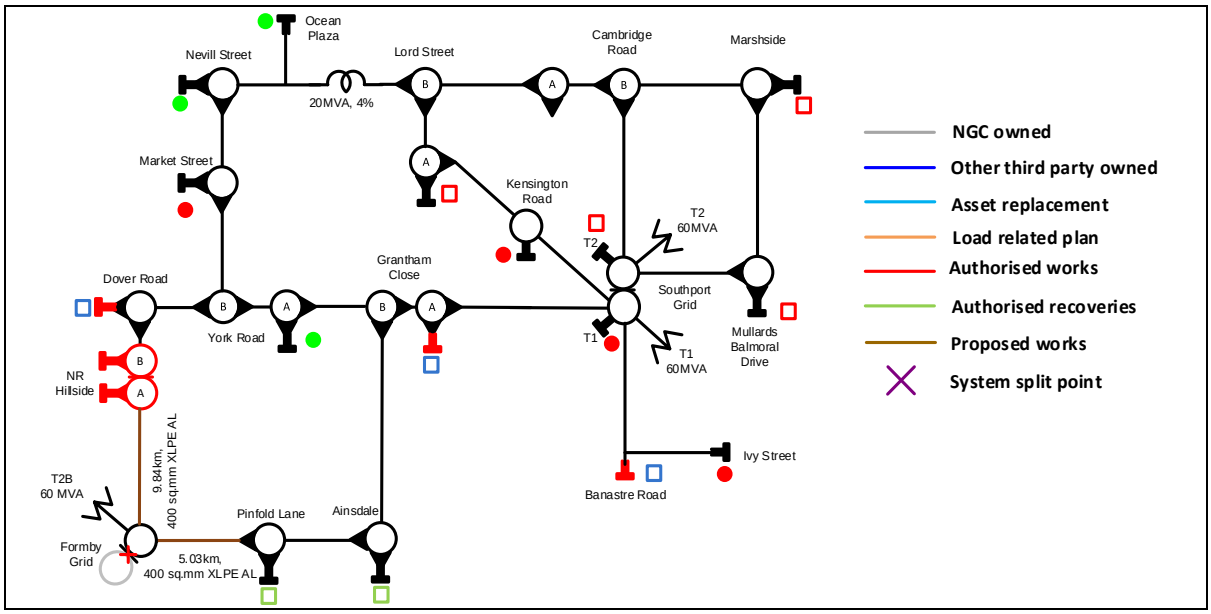

Figure 5-5: Schematic of Option-3

Table 5-11: Reinforcement costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non-Pressurised)	14.87	3.608	3.608	-
Pilot Wire Underground	6.54	0.724	0.724	-
Wayleaves/Easements/Land Purchase		0.250	0.250	-
Other Costs (Identify Below)		0.400	0.400	-
Total Costs		**4.982**	**4.982**	
£250k for OHL recoveries				
£100k for modern relays and protection changes				
£50k for engineering time				

5.5 Options Technical Summary

Summary of the costs for each of the evaluated options is presented in Table 5-12.

Table 5-12: Options Summary

Options	Contribution(£m)	RIIO-ED2 Cost (£m)
Baseline	New 33kV interconnector circuit	6.323
Option 1	Overlay the UGC & re-conductor the OHL limiting sections	2.031
Option 2	Overlay the limiting UGC & underground the OHL sections	3.995
Option 3	Overlay all the UGC & underground all the OHL sections.	4.982

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 install a new 14km long 33kV interconnector circuit between Formby and Southport to mitigate the thermal overload issues in the group. The adopted solution is enduring, provides an additional uplift of 28MVA to the group and meet the demand growth in the group beyond RIIO-ED3.

6.2 Cost Benefit Analysis

A cost-benefit analysis was carried out to compare the NPV of the baseline and 3 alternate options discussed in the previous sections. Considering the lowest forecast capital expenditure, the adopted Baseline option has the highest NPV considering that the alternate options needs further reinforcements and investment beyond RIIO-ED2 period. Based on the outcome of the CBA, the Baseline option is adopted which is a conventional build solution to install a new 33kV, 14km long interconnector between Formby and Southport Grid substations. The adopted option also contributes to losses reduction, the benefits are included under societal costs in the CBA.
The summary of the cost benefit analysis is presented in Table 6-1. The full detailed CBA is provided within "ED2-LRE-SPM-012-CV1-CBA- Formby - Southport 33kV Reinforcement".

Table 6-1: Options Summary

Options considered	Decision	Comment	NPVs based on payback periods (£m) in 2020/21 prices			
			10 years	20 years	30 years	45 years
Baseline - New 33kV interconnector circuit	**Adopted**		0.0	0.0	0.0	0.0
Option 1-Replant UGC & reconductor OHL the limiting sections on both Formby ckts	Rejected	Discounted based on NPV.	0.19	-0.31	-0.63	-0.89
Option 2-Replant limiting UGC & new UGC replacing OHL sections on both Formby ckts	Rejected	Discounted based on NPV.	-0.69	-1.62	-2.18	-2.63
Option 3-Replant all the UGC/OHL sections on both Formby ckts	Rejected	Discounted based on NPV.	-1.27	-2.40	-3.08	-3.62

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 £6.323m.

Table 6-2: Adopted option costs and volumes

Asset Description	Volumes	Prime Costs (£m)	RIIO-ED2 Contribution (£m)	Customer Contribution (£m)
33kV UG Cable (Non-Pressurised)	14.10	3.421	3.421	-
33kV CB (Gas Insulated Busbars) (ID) (GM)	1.00	0.170	0.170	-
Pilot Wire Underground	14.00	1.551	1.551	-
Civil Works at 33 kV & 66 kV Substations	-	0.037	0.037	-
Wayleaves/Easements/Land Purchase	-	0.112	0.112	-
Flexibility Services	-	0.037	0.037	
Other Costs	-	0.500	0.500	-
Total Cost		**6.323**	**6.323**	**-**
£42k for upgrading relays/protection changes for each CB				
£40k for CB refurbishment at Southport grid substation				
£300k for traffic management on the 'A565' road				
£50k for engineering. Time				
£50k costs to include stakeholder engagement				
£50k for environmental and sustainability assessments				

Table 6-3: Cost incidence over the RIIO-ED2 period

Investment category	Total	Incidence (£m)				
	(£m)	2023/24	2024/25	2025/26	2026/27	2027/28
CV1 (Primary reinforcement)	6.286	2.095	2.095	2.095	-	-
CV1(Flexible Services)	**0.037**	0.008	0.012	0.018	-	-
Total Cost	**6.323**	2.103	2.107	2.113	-	-

6.4 Risks

The Formby-Southport grid supplies to the coastal areas around Sefton Coast, a designated Special Area of Conservation (SAC). The proposed option is minimum risk option compared with the alternative options as they require works on the circuits running through the environmentally sensitive areas.

Cable installations/overlay is a BaU activity, hence there is little risk associated with the proposed scheme. In terms of delivery of the proposed option, much of the 14km circuit route is along the A565 road which in the initial assessments came out to be the minimum risk route. An early engagement with the Sefton Council and other stakeholders is necessary and costs have been allocated to this extent.

The project is expected to be delivered in 2025/26 across three outage seasons, the delivery will be aligned with the overall SPM ED2 plan for better co-ordination of outages and reducing the network risk.

The past track record of asset interventions including cables is presented in "Annex 4A.1: Future System Strategy" of our RIIO-ED2 Business plan.

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 driver for this investment is insufficient thermal headroom and security of supply risk to over 44,750 customers which is due to the forecast DFES demand. The group's thermal capacity is limited by the OHL sections in the Formby circuits, the proposed scheme addresses the thermal constraints by installing a network path in the form of 14km interconnector from Formby to Southport.

6.6.2 Payback Periods

The CBA indicates that a positive NPV result in all assessment periods (10, 20, 30 & 45 years). As the intervention is forecast to carry at least a 45-year asset life expectancy, the positive 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 has been tested against and has been found to be consistent with the network requirements determined in line with the section 9 of the Electricity Act and License Condition 21. Additionally, the proposed option is consistent with the SPEN's DSO vision and future network strategy.

For the Formby-Southport 33kV group, 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.

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	Headwinds	Widespread Engagement	Widespread Innovation	Tailwinds
EVs	10,189	7,719	14,029	16,165	14,733	10,189	16,017	14,606	14,606
HPs	3,819	1,478	5,332	4,698	4,345	3,719	4,664	4,249	4,138

** 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

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

R^{I} – New 33kV Interconnector circuit

The proposed solution is robust across the range of future pathways. The selected solution is required under all scenarios. In all cases this solution is expected to cater for network capacity requirements to beyond RIIO-ED3. The timing of the requirement is only 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)	6.323	0.0
Comment	Proposed option.	N/A

6.6.4 Asset Stranding Risks & Future Asset Utilisation

Electricity generation, demand and system transfers are forecast to increase under all scenarios. The stranding risk is therefore considered to be very low. It has been assessed that the preferred option is consistent with the future generation and demand scenarios and that the risk of stranding is very low.

6.6.5 Losses / Sensitivity to Carbon Prices

Losses for the Formby-Southport have been considered as part of the optioneering exercise and the incremental losses for each of the considered option is included in the CBA under societal benefits. The proposed Baseline option is effective in reducing the losses by 0.08% of the total energy consumed (as per PI Historian data from 2020/21) which amounts to ca. 241MWh / year. The incremental losses are projected up to the year 2050 using the DFES demand forecasts.

During the evaluation of the options associated with the proposed scheme, we have included within the CBA the assessed network losses, an assessment of the embodied carbon and the associated carbon cost under societal benefits to inform our NPV evaluation, where data is available.

The adopted baseline option involving the 14km Formby-Southport interconnector has shown to effective in reducing the total losses compared to the other options.

The mass of carbon dioxide emitted (CO2e) during the manufacture of the main equipment deployed to deliver the proposed option scheme is estimated to be 181.84 tonnes over the ED2 period, the monetised embodied carbon value associated with this emission is £9,210.

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

6.6.6 Whole Systems Benefits

Whole system benefits have been considered as part of this proposal as the recommended solution enables to create additional thermal headroom in the group and addresses the thermal overloads in the group.

6.7 Environmental Considerations

6.7.1 Operational and embodied carbon emissions

The Formby-Southport 33kV Reinforcement programme has the potential to result in the emissions of embodied carbon arising from the delivery of the programme. There is likely to be little or no impact on SPEN's Business Carbon Footprint (BCF).

Upfront costs associated with this programme (e.g. embodied carbon from the manufacture and supply of components and associated civil engineering works) should be considered against our ongoing operational need to maintain the resilience of our assets and networks.

6.7.2 Supply chain sustainability

For us to take full account of the whole-life carbon impact of our Formby-Southport 33kV Reinforcement programme, we need access to reliable data to be provided by 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 Formby-Southport 33kV 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

Some aspects of the Formby-Southport 33kV Reinforcement programme will only affect developed sites containing existing assets, so the impact on, and the opportunity to improve biodiversity and natural capital is expected to be limited.

For the new 14km interconnector UGC circuit between Formby & Southport Grid substations, however, SPEN will seek to reduce impacts on the natural environment. As stated in Section 6.8, proposed alternative options which involve works on Formby to Hillside 33kV circuit have been rejected based on environmental concerns requiring extensive surveys on the environmentally sensitive Sefton coast.

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, and our use of underground cables instead of overhead lines helps to minimise our overall 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.

The proposed alternate options involve works on Formby – Hillside 33kV circuit including, either re-conducting of the OHL or replacing the OHL circuit with UGC etc., which are rejected based on environmental concerns requiring extensive surveys on the environmentally sensitive Sefton coast.

The adopted solution will take account sustainability initiatives associated with this SAC and reflect wider licenced business sustainable development objectives set out in the Environmental Action Plan (EAP). The scheme will avoid environmental impacts where possible and provide mitigation and improvements when required, and all relevant environmental and planning consents will be secured.

7 Conclusion

Formby - Southport 33kV grid group is located within the Kirkby 132kV GSP group and provides supplies to 44,750 customers across the Sefton coastal regions of Ainsdale, Birkdale, Formby, and Southport. Detailed network studies involving all N-1 / N-1-1 outages have identified a thermal constraint on the two outgoing interconnector circuits from Formby Grid substation Formby – Hillside and Formby-Pinfold Lane 33kV circuits and exacerbated by the forecast LCT uptake. The DFES forecast demand is expected to exceed the group's firm capacity in the early ED2 period under N-1-1 conditions and in the middle of ED2 period under N-1 conditions.

The proposed solution is a conventional build solution involving a new 33kV interconnector circuit between Formby and Southport Grid substations at a total cost of £6.323m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. The proposed solution gives the highest thermal headroom uplift of ca.28 MVA to meet the forecast demand growth beyond ED3 period (2033) when compared with the alternative schemes identified.

DFES forecasts indicate the firm capacity exceedances midway of RIIO-ED2. Therefore, it is proposed to start the works 2023/24 at the start of ED2, with completion in 2025/26. A capacity release of 28MVA will be claimed in 2025/26 at the end of the project.

8 Appendices

8.1 Network Constraint Study Results

Table 8-1: N-1 / N-1-1 Assessment results

Violation Description	Network Item	Flow (MVA)	Rating (MVA)	Loading (%)	Season	Outage	Contingency
Exceeds 100% Winter FCO Rating	FORB E1.PINFOL.5.029 km	23.0	22.6	102	Winter	N-1	FORB E1 - HILLS A [9.84 km]
Exceeds 100% Winter FCO Rating	FORB E1.HILLS A.9.84 km	22.9	23	100	Winter	N-1	FORB E1 - PINFOL [5.029 km]
Exceeds 100% Summer FCO Rating	FORB E1.PINFOL.5.029 km	20.1	20.0	101	Summer	N-1	FORB E1 - HILLS A [9.84 km]

Exceeds 100% Summer FCO Rating	FORB E1.HILLS A.9.84 km	20.1	20.0	100	Summer	N-1	FORB E1 - PINFOL [5.029 km]
Exceeds 100% Summer SCO Rating	FORB E1.HILLS A.9.84 km	28.5	25.1	114	Summer	N-1-1	KIBY-SPOR & PENW-SPOR-132kV
Exceeds 100% Summer SCO Rating	FORB E1.PINFOL.5.029 km	28.7	25.4	113	Summer	N-1-1	KIBY-SPOR & PENW-SPOR-132kV
Exceeds 100% Summer SCO Rating	AINSDA.PINFOL.1.406 km	26.0	25.8	100	Summer	N-1-1	KIBY-SPOR & PENW-SPOR-132kV

8.2 Profile based study result

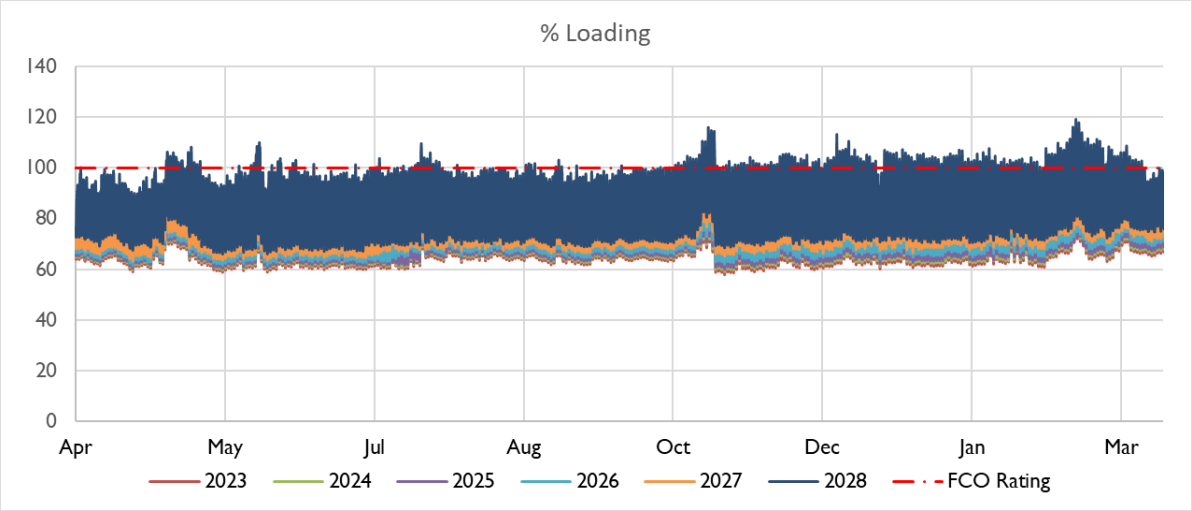

Figure 8-1: Half hourly loading of Formby – Pinfold Lane circuit

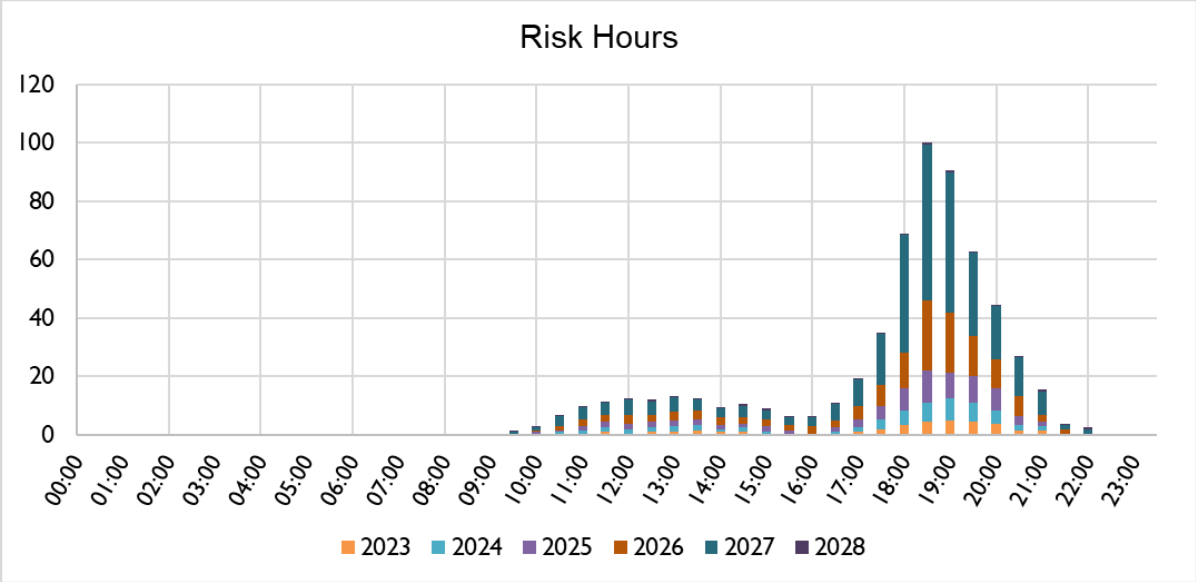

Figure 8-2: Calculated daily network risk window