New Transmission Capacity Charges

ED2 Engineering Justification Paper

ED2-LRE-SPEN-001-CV4-EJP

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

Scheme Name	New Transmission Capacity Charges		
Activity	New Transmission Capacity Charges		
Primary Investment Driver	Covering multiple GSP sites with Thermal or Fault Level Constraints requiring transmission network intervention		
Reference	ED2-LRE-SPEN-001-CV4		
Output	CV4		
Cost	SPD: £18.123m	SPM: £0.000m	
Delivery Year	2023-2028		
Reporting Table	CV4		
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**
	£12.821m	**£18.123**	**£18.042m**

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:	**New Transmission Capacity Charges**
Project Reference:	**ED2-LRE-SPEN-001-CV4**
Decision Required:	**To give concept approval for New Transmission Capacity Charges (NTCC).**

Summary of Business Need:

SP Energy Networks (SPEN) network is connected to transmission via Transmission Connection Points (TCPs), also referred to as Grid Supply Points (GSPs). Our SP Manweb (SPM) network is connected to National Grid Electricity Transmission (NGET) and our SP Distribution (SPD) network is connected to SP Transmission (SPT). NGET and SPT provide infrastructure at these exit points to allow power to flow between the transmission system and the distribution network.

Distributed generation growth and Low Carbon Technologies (LCT) uptake is expected to continue and accelerate as UK generation decentralises to meet Net Zero targets. The distribution networks must be prepared to accommodate these levels of forecast generation and demand. Without this, the network assets will be stressed beyond the design limits, which can lead to additional network constraints and risk security of supply to the distribution customers. Due to high level of predicted demand and generation, the collaborative approach between distribution and transmission is needed to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solution is selected.

In SPD licence area, where transmission incorporates the 132kV system, there are more 132/33kV GSPs with lower capacities. Also, there is high levels of fault level infeed from the transmission side at 275/33kV GSPs which has exacerbated due to the increase of embedded generation and new load connections to the SPD network. In SPM licence area, there is a requirement for increased operational flexibility within RIIO-ED2 due to growth of both demand and generation.

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

Within SPD, our analysis indicated that several sites would require a fault level mitigation from SPT side and there will be a need for additional connection points in RIIO-ED2. We have worked collaboratively with SP Transmission to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solutions are selected.

Within SPM, our analysis indicated that one GSP will require works on the NGET side to increase operational flexibility within RIIO-ED2. The estimated total cost for the new transmission capacity charges is £22.232m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure. £4.110m of this expenditure relates to RIIO-ED2 schemes with SPT/NGET elements included within the named scheme engineering justification papers (EJP). **The remaining £18.123m of CV4 costs are claimed in this EJP.**

Expenditure Forecast (Where available based on Regulatory Allowance – 2020/21)

Recommended Scheme Investment Profile	Total (£m)	Incidence (£m)				
		2023/24	2024/25	2025/26	2026/27	2027/28
CV4 - New Transmission Capacity Charges (**SPD**)	**18.123**	2.893	3.884	3.826	3.782	3.738
CV4 - New Transmission Capacity Charges (**SPM**)	**-**	-	-	-	-	-

PART B – PROJECT SUBMISSION

Proposed by Milana Plecas	Signature Milana Plecas	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

SP Energy Networks (SPEN) network is connected to transmission via Transmission Connection Points (TCPs), also referred to as Grid Supply Points (GSPs). Our SP Manweb (SPM) network is connected to National Grid Electricity Transmission (NGET) and SP Distribution (SPD) network is connected to SP Transmission (SPT). NGET and SPT provide infrastructure at these exit points to allow power to flow between the transmission system and the distribution network.

Distributed generation growth and Low Carbon Technologies (LCT) uptake is expected to continue and indeed accelerate as UK generation decentralises to meet Net Zero targets. The distribution networks must be prepared to accommodate these levels of forecast generation and demand. Without this, the network assets will be stressed beyond the design limits, which can lead to additional network constraints and risk security of supply to the distribution customers. Due to high level of predicted demand and generation, the collaborative approach between distribution and transmission is needed to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solution is selected.

In SPD licence area, where transmission incorporates the 132kV system, there are more 132/33kV GSPs with lower capacities. Also, there is high levels of fault level infeed from the transmission side at 275/33kV GSPs which has exacerbated due to the increase of embedded generation and new load connections to the SPD network. In SPM licence area, there is a requirement for increased operational flexibility within RIIO-ED2 due to growth of both demand and generation.

Within SPD, our analysis indicated that several sites would require a fault level mitigation from SPT side and there will be a need for additional connection points in RIIO-ED2. We have worked collaboratively with SP Transmission to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solutions are selected. Within SPM, our analysis indicated that one GSP will require works on the NGET side to increase operational flexibility within RIIO-ED2.

The estimated total cost for the New Transmission Capacity Charges (CV4) is £22.232m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

£2.534m of SPD CV4 costs are covered in four named scheme engineering justification papers (EJP) listed in Table 4-2, with the remaining **£18.123m** claimed in this EJP.

£1.576m of SPM CV4 costs are covered in "ED2-LRE-SPM-030-CV1-EJP - Legacy 132kV Reinforcement" EJP, with no costs claimed in this EJP.

2 Background Information

New transmission capacity charges cover projects to be carried out by transmission licensees at transmission connection points initiated by the distribution network operators for increased capacity at existing transmission connection points or for new transmission connection points. There are two categories of charges, for reinforcement of existing transmission connection points and for new transmission connection points. These charges are related to transmission connection assets and represents annual charges from a year of commissioning of the assets based on depreciation period over 40 years.

The basic connection charge has two components, a capital component and a non-capital component.

The capital component is the Net Asset Value (NAV) of each asset for year n, which is the average (mid-year) depreciated the Gross Asset Value (GAV) of the asset. The Rate of Return (RoR) is applied to the NAV and the GAV represents the initial total cost of an asset to the transmission licensee. For a new asset it will be the costs incurred by the transmission licensee in the provision of that asset.

The non-capital component of the connection charge is divided into two parts, Site Specific Maintenance charges and Transmission Running Costs. These are set to 0.37% and 1.06% respectively for both SPD and SPM as per National Grid ESO (NGESO) Chargebooks 2021.

If a capital contribution for a connection asset is paid in full pre-commissioning then no capital charges will be payable, just the non-capital component.

3 Needs Case

Distribution networks will be key players in achieving the Net Zero targets. The distribution networks can contribute to achieving the Net Zero targets by integrating increasing amounts of distributed generation, whilst facilitating decarbonizing of the heat and transport sectors by electrification through the increasing LCT uptake in the form of electric vehicles (EVs) and heat pumps (HPs).

Simultaneously, the distribution networks must be prepared to accommodate these levels of forecast generation and demand; without which the network assets will be stressed beyond the design limits. In SPD licence area, where transmission incorporates the 132kV system, there are more 132/33kV Grid Supply Points (GSPs) with lower capacities. Also, there is high levels of fault level infeed from the transmission side at 275/33kV GSPs which has exacerbated due to the increase of embedded generation and new load connections to the SPD network. In SPM licence area, there is a requirement for increased operational flexibility within RIIO-ED2 due to growth of both demand and generation.

3.1 Forecast Demand

Our DFES forecasts show that in SP Distribution network area demand could increase by 26% by 2030 without flexibility and double by 2050. With flexibility, demand could increase by 15% by 2030 and 55% by 2050. There could be as many as 914,000 electric vehicles and the total proportion of homes with a heat pump could reach 26% by 2030.

Our DFES forecasts show that in SP Manweb network area demand could increase by up to 26% by 2030 without flexibility and more than double by 2050. With flexibility, demand could increase by 15% by 2030 and over 60% by 2050. There could be as many as 571,000 electric vehicles and the total proportion of homes with a heat pump could reach 24% by 2030.

3.2 Forecast Generation

In both SPD and SPM networks, growth in generation connections is expected to continue and indeed accelerate as UK generation decentralises to meet Net Zero targets. SPEN Distribution Future Energy Scenarios (DFES) forecast that by 2030 distribution generation is likely to triple in SPD (reaching ca. 7GW) and double in SPM (reaching over 5GW).

All scenarios show a significant increase in generation. Most of the increase in capacity is expected to come from wind, PV, and storage. Figure 1 and Figure 2 show the geographical split of installed generation and storage capacity by GSP area at 2030 and 2050.

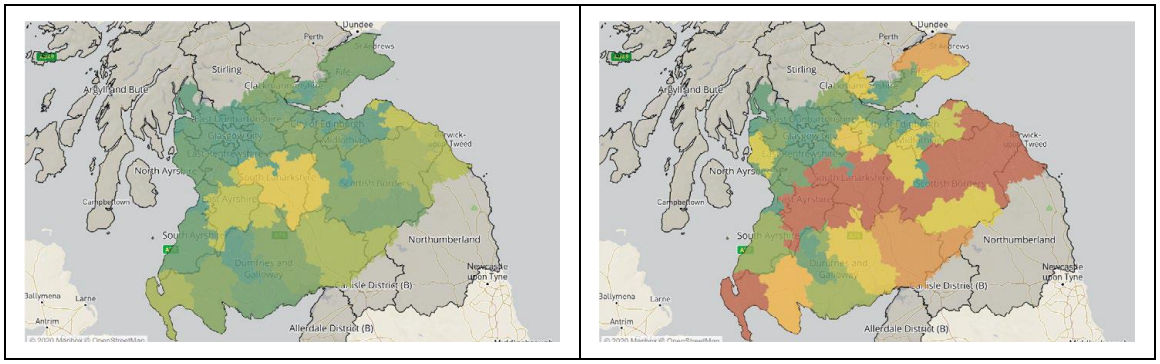

Figure 1. SPD GSP installed generation and storage capacity by GSP area at 2030 and 2050

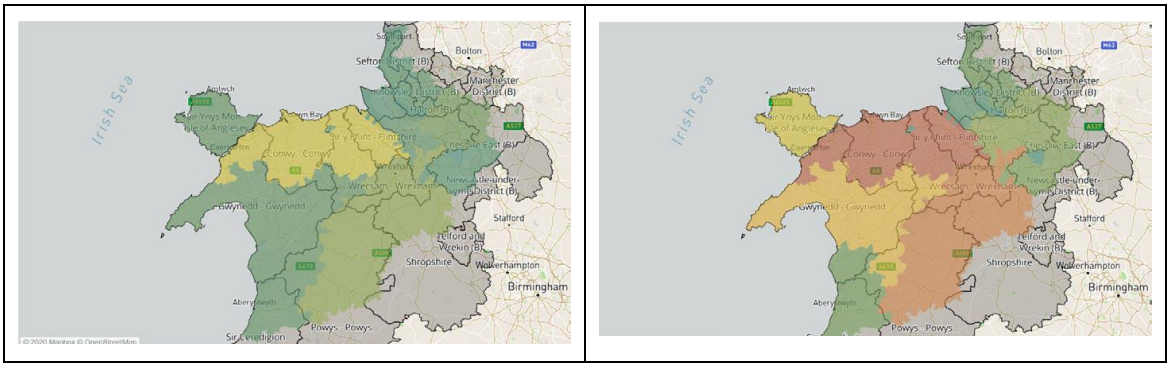

Figure 2. SPM GSP installed generation and storage capacity by GSP area at 2030 and 2050

4 Summary Breakdown of New Transmission Capacity Charges

A summary of the proposed levels of CV4 expenditure under RIIO-ED2 is shown in Table 4-1. Table 4-2 & Table 4-3 detail allowed expenditure by licence area and project.

Table 4-1. Summary of allowed expenditure under RIIO-ED2, £m (2020/21 Prices)

Project		2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
RIIO-ED2 schemes with SPT/NGET elements*	SPD	-	-	0.643	0.737	1.154	**2.534**
	SPM	-	1.550	0.009	0.009	0.009	**1.576**
CV4 costs covered in scheme EJPs		**-**	**1.550**	**0.652**	**0.746**	**1.163**	**4.110**
Schemes in SPT RIIO-T2	SPD	0.869	1.876	1.846	1.825	1.803	**8.219**
RIIO-ED1 / RIIO-T1 Projects		1.811	1.796	1.767	1.745	1.722	**8.841**
Customer Driven Projects		0.213	0.213	0.213	0.213	0.213	**1.063**
CV4 costs not covered elsewhere		**2.893**	**3.885**	**3.826**	**3.783**	**3.738**	**18.123**
Total CV4	**SPD**	2.893	3.885	4.469	4.520	4.892	**20.656**
	SPM	-	1.550	0.009	0.009	0.009	**1.576**
	SPEN	**2.893**	**5.434**	**4.477**	**4.527**	**4.901**	**22.232**

* CV4 costs for RIIO-ED2 schemes with NGET/SPT elements are covered within scheme EJP

Table 4-2. SPD Summary of allowed expenditure under RIIO-ED2 per projects, £m (2020/21 Prices)

Project		CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
RIIO-ED2 schemes with SPT elements	Currie GSP* *ED2-LRE-SPD-004-CV3-EJP*	TCPs reinforced	-	-	0.333	0.329	0.326	**0.988**
	New Moffat GSP* *ED2-LRE-SPD-021-CV1-EJP*	TCPs new	-	-	0.235	0.233	0.230	**0.698**
	New Lesmahagow GSP* *ED2-LRE-SPD-020-CV3-EJP*	TCPs new	-	-	0.058	0.159	0.583	**0.800**
	Whitehouse GSP* *ED2-LRE-SPD-015-CV3-EJP*	TCPs reinforced	-	-	0.016	0.016	0.016	**0.047**
Total CV4 costs covered in scheme EJPs			**-**	**-**	**0.643**	**0.737**	**1.154**	**2.534**
Fault level schemes included in SPT RIIO-T2	East Kilbride GSP	TCPs reinforced	-	0.198	0.195	0.193	0.190	**0.776**
	Kilmarnock Town GSP	TCPs reinforced	0.349	0.665	0.654	0.647	0.639	**2.954**
	Newarthill GSP	TCPs reinforced	-	0.243	0.240	0.237	0.234	**0.954**
	Port Dundas GSP	TCPs reinforced	-	0.258	0.254	0.251	0.248	**1.010**
	Strathaven GSP	TCPs reinforced	0.264	0.259	0.255	0.252	0.249	**1.279**
	West George Street GSP	TCPs reinforced	0.257	0.252	0.248	0.246	0.243	**1.246**
RIIO-ED1/RIIO-T1 Projects		TCPs reinforced	1.114	1.111	1.093	1.079	1.065	**5.463**
		TCPs new	0.697	0.685	0.674	0.665	0.657	**3.378**
Customer Driven Projects		TCPs reinforced	0.213	0.213	0.213	0.213	0.213	**1.063**
Total CV4 costs not covered in scheme EJPs			**2.893**	**3.884**	**3.826**	**3.782**	**3.738**	**18.123**
SPD Total CV4			**2.893**	**3.884**	**4.469**	**4.519**	**4.892**	**20.656**

* CV4 costs for RIIO-ED2 schemes with NGET elements are covered within scheme EJPs

Table 4-3. SPM Summary of allowed expenditure under RIIO-ED2 per projects, £m (2020/21 Prices)

Project		CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
RIIO-ED2 schemes with NGET element	Legacy GSP* ED2-LRE-SPM-030-CV1-EJP	TCPs reinforced	-	1.550	0.009	0.009	0.009	**1.576**
Total of CV4 costs covered in scheme EJPs			-	1.550	0.009	0.009	0.009	**1.576**
Total of CV4 costs not covered in scheme EJPs			-	-	-	-	-	-
SPM Total CV4			**-**	**1.550**	**0.009**	**0.009**	**0.009**	**1.576**

* CV4 costs for RIIO-ED2 schemes with NGET elements are covered within CV1 EJP and CBAs

4.1 SPD: Schemes Included in SPT RIIO-T2 to Mitigate Fault Levels at 33kV GSPs

Following our analysis during RIIO-ED1 and for RIIO-ED2, it was identified that a number of SPD GSP sites will require a fault level mitigation which will involve SP Transmission works at the transmission connection assets at these sites.

The increase of embedded generation and a new load connecting to the SPD distribution network has exacerbated the existing high levels of fault level infeed at six 275/33kV sites. These are East Kilbride GPS, Kilmarnock Town GSP, Newarthill GSP, Port Dundas GSP, Strathaven GSP and West George Street GSP.

The fault level infeed at these GSPs is either beyond or reaching the system design limits for both peak make and RMS break. Under design policy, the fault level mitigation is deemed necessary above 95% threshold. Therefore, these sights require enduring reinforcement solutions in RIIO-ED2 to reduce the risks caused by overstressing equipment and to increase the hosting capacity for new connections by making additional fault level headroom available.

The fault levels at these six GSPs with connected and contracted generation and the load growth within RIIO-ED2 period are shown in Table 4-4 below.

Table 4-4. Authorised fault levels at six 275/33kV sites

Substation Name		Peak Make	RMS Break
East Kilbride GSP	3-phase Fault Level (kA)	53.51	18.86
	Design Rating (kA)	50	17.5
	Duty (%)	**107%**	**108%**
Kilmarnock Town GSP	Fault Level (kA)	58.73	20.29
	Design Rating (kA)	50	17.5
	Duty (%)	**117%**	**116%**
Newarthill GSP	Fault Level (kA)	55.03	19.14
	Design Rating (kA)	50	17.5
	Duty (%)	**110%**	**109%**
Port Dundas GSP	Fault Level (kA)	48.74	17.32
	Design Rating (kA)	50	17.5
	Duty (%)	**97%**	**99%**
Strathaven GSP	Fault Level (kA)	51.99	18.42
	Design Rating (kA)	50	17.5
	Duty (%)	**104%**	**105%**
West George Street GSP	Fault Level (kA)	50.14	17.65
	Design Rating (kA)	43.75	17.5
	Duty (%)	**115%**	**101%**

During RIIO-T2 preparation we worked collaboratively with SP Transmission to undertake a whole system approach to identify the most economic and efficient solutions for these sites. Both transmission and distribution solutions were evaluated in cooperation with SPT and it was identified that a reduction in fault levels to a value less than the network design rating (1,000MVA, 17.5kA) can only be achieved with the works on the SPT side.

SP Distribution therefore submitted Modification Applications (ModApps) for these sites to National Grid Electricity System Operator (NGESO) in December 2019. These sites were assessed and included in RIIO-T2 plan and SPD received and accepted the NGESO offers in August 2020.

Several SPD and SPT options have been considered for the above sites and they were presented in the SPT RIIO-T2 papers. The final solution for each site is detailed in the accepted NGESO ModApp offers. For each substation SP Distribution has no on-site works to perform. All proposals are solely for the installation or removal of transmission connection assets. A summary of proposed solutions and RIIO-T2 papers is shown in Table 4-5.

Table 4-5. Solutions at six 275/33kV sites

Substation Name	Accepted Solution included in the ModApp offers	RIIO-T2 Scheme Reference	RIIO-T2 Scheme Solution
East Kilbride GSP	Bus section reactor on SPT network via 2 x three-panel 33kV switchboards	SPT20083	Installation of two 33kV series reactors on the LV circuits of the existing 275/33kV 120MVA transformers
Kilmarnock Town GSP	Dual LV winding transformer Installation	SPT20063	Replacement of both grid transformers with new dual-winding (60MVA + 60MVA) units
Newarthill GSP	Bus section reactor on SPT network via 2 x three-panel 33kV switchboards	SPT20060	Replacement of both grid transformers with new dual-winding (60MVA + 60MVA) units
Port Dundas GSP	Replacement of SGT2 transformer with 90VMA unit	SPT20073	Replacement of both grid transformers with 90MVA units
Strathaven GSP	Replacement of SGT1 transformer to 90MVA unit	SPT20080	Replacement of SGT2 transformer with a 90MVA unit
West George Street GSP	Replacement of SGT2 transformer with 90VMA unit	SPT200103	Replacement of both grid transformers with 90MVA units

East Kilbride GSP

SPT will install a three-panel switchboard into the single core cabling between each supergrid transformer and the 33kV incomer on the East Kilbride switchboard. A 30MVA reactor will be connected between each three-panel switchboard to provide an alternative path when the bus-section circuit breaker on the main switchboard is operated in the normally open position, thereby limiting the fault level infeed from the transmission system. Based on the accepted ModApp offer, the connection date for the reactor is May 2024.

Kilmarnock Town GSP

SPT will replace both 120MVA 275/33kV supergrid transformers. The new transformers will have dual 33kV windings (60MVA + 60MVA) to supply the "A" and "B" 33kV switchboards. Based on the accepted ModApp offer, the connection date for the new SGT1 is October 2023 and for the new SGT2 is September 2024.

Newarthill GSP

SPT will install a three-panel switchboard into the single core cabling between each supergrid transformer and the 33kV incomer on the Newarthill switchboard. A 45MVA reactor will be connected between each three-panel switchboard to provide an alternative path when the bus-section circuit breaker on the main switchboard is operated in the normally open position, thereby limiting the fault level infeed from the transmission system. Based on the accepted ModApp offer, the connection date for the reactor is May 2024.

Port Dundas GSP

SPT will replace the 120MVA SGT2 transformer with a 90MVA 275/33kV unit. The new higher impedance transformer, when in parallel with SGT1, will lower the fault infeed from the transmission system to a value less than the system design limit (33kV – 1,000MVA). Based on the accepted ModApp offer, the connection date for the new SGT2 is October 2024.

Strathaven GSP

SPT will replace the 120MVA SGT1 transformer with a 90MVA 275/33kV unit. The new higher impedance transformer, when in parallel with SGT2 will lower the fault infeed from the transmission system to a value less than the system design limit (33kV – 1,000MVA). Based on the accepted ModApp offer, the connection date for the new SGT1 is October 2023.

West George Street GSP

SPT will replace the 120MVA SGT2 transformer with a 90MVA 275/33kV unit. The new higher impedance transformer, when in parallel with SGT1 will lower the fault infeed from the transmission system to a value less than the system design limit (33kV – 1,000MVA). Based on the accepted ModApp offer, the connection date for the new SGT2 is October 2023.

New transmission capacity charges (TCPs reinforced) will be applicable upon completion of the proposed works. A summary of transmission capacity charges for these six schemes is shown in Table 4-6.

Table 4-6. Summary of CV4 expenditure for 275/33kV sites under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	0.869	1.876	1.846	1.825	1.803	**8.219**
TCPs new	-	-	-	-	-	**-**
Total	**0.869**	**1.876**	**1.846**	**1.825**	**1.803**	**8.219**

4.2 SPD: Scheme to Mitigate Fault Level at Currie 11kV GSP

Currie 132/11kV GSP has been identified as a candidate for load reinforcement during the RIIO-ED2 price control period due to the fault level issues. The peak-make fault levels at Currie GSP 11kV already exceed 100% of the design fault level limits and the RMS break duty is approaching 95% of the design fault level limits (250MVA). Although the 11kV switchgear at Currie is rated at 350MVA, the 11kV network design fault level limit of 250MVA should not be exceeded due to the wider impact on downstream equipment and customers (particularly customers connected at 11kV with unknown equipment capability), which will have been designed up to a maximum fault level infeed of no greater than 250MVA. Since 2018 several applications have been withdrawn due to the issue of fault level infeed into the site with approximately 20MW of generation applications unable to proceed due to the fault level constraints at the site.

In order to resolve fault level issues, the proposal is to standardise the site by establishing a 132/33kV GSP (2 x 60MVA), a new indoor 33kV board and a local Currie primary 33/11kV (2 x 20MVA) substation.

The SP Distribution works for this solution involves the installation of a new 5-panel indoor 33kV switchboard with space for an additional panel on each side and two 33/11kV primary transformers. The new 33kV board will comprise of five panels, two of which are feeder breakers, a bus section and two transmission incomer breakers, with the facility for an additional circuit breaker on each side for future connections. The new 33/11kV 20MVA transformers will connect to the existing 11kV board. The costs of SPD works are included within the CV3 expenditure.

The SP Transmission works for this solution involves the installation of two 132/33kV 60MVA grid transformers, associated cable works and two transmission 33kV incomer breakers. The full cost of transmission works will be charged to SP Distribution and funded through CV4 (TCPs reinforced) upon the new GSP energisation. SP Distribution will submit a ModApp to NGESO for these works in 2021. Based on our discussion with SPT, it is envisaged that the SPT works will be completed in late 2025.

The details of this scheme are detailed in the paper 'ED2-LRE-SPD-004-CV3-EJP – Currie GSP Fault Level Mitigation' and a summary of transmission capacity charges is shown in Table 4-7.

Table 4-7. Summary of CV4 expenditure for Currie GSP under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	-	-	0.333	0.329	0.326	**0.988**
TCPs new	-	-	-	-	-	**-**
Total	**-**	**-**	**0.333**	**0.329**	**0.326**	**0.988**

4.3 SPD: New Grid Supply Point Near Moffat primary in Dumfries and Galloway

Following our analysis during RIIO-ED1 period it was identified that there will be a need for the establishment of an additional connection points near Moffat primary in Dumfries and Galloway within RIIO-ED2 period.

SP Distribution submitted a ModApp for this new GSP to NGESO in January 2020. This new GSP was assessed and included in the RIIO-T2 plan and SPD received and accepted the NGESO offer in November 2020.

Chapelcross 132/33 kV Grid Supply Point (GSP) is in Dumfries and Galloway District of the SP Distribution (SPD) licence area, near the Scottish Border. The primary driver for investment at Moffat substation is to alleviate thermal and voltage constraints on the 33kV network associated with Lockerbie, Kirkbank and Moffat primary substations fed from Chapelcross GSP. This network is rural, and infrastructure is relatively sparse. It is becoming problematic to accommodate additional demand and generation in this area.

Lockerbie/Kirkbank/Moffat demand group providing supplies to ca. 7,302 customers. It is a class 'C' of supply as per Energy Network Association (ENA) Engineering Recommendation (EREC) P2/7. The group has a firm capacity of 20.86MVA winter. Our baseline View forecasts a peak demand of 24MVA,

with an expected uptake of 2,144 electrical vehicles and 1,414 heat pumps by the end of RIIO-ED2 period.

It is proposed to establish a new 132/33kV GSP substation connecting into Moffat 132kV transmission network. The GSP will utilise an existing 60MVA transformer installed for the transmission connected Minnygap wind farm.

The SP Distribution works for this solution involves the installation of a new indoor 33kV switchboard and 33kV circuits to connect to the new board. The costs of SPD works are included within the CV1 expenditure.

The SP Transmission works for this solution involves the installation of 1 x 60MVA 132/33kV grid transformers, 1 x 132kV feeder bay, two transmission incomer breakers and associated cable works. The full cost of transmission works will be charged to SP Distribution and funded through CV4 (TCPs new) upon the new GSP energisation. Based on the accepted ModApp offer, the connection date for Moffat GSP is August 2025.

The details of this scheme are detailed in the paper 'ED2-LRE-SPD-021-CV1-EJP – New Moffat GSP' and a summary of new transmission capacity charges is shown in Table 4-8.

Table 4-8. Summary of CV4 expenditure for Moffat GSP under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	-	-	-	-	-	**-**
TCPs new	-	-	0.235	0.233	0.230	**0.698**
Total	**-**	**-**	**0.235**	**0.233**	**0.230**	**0.698**

4.4 SPD: New Grid Supply Point Near Lesmahagow in Lanarkshire

Following our analysis during RIIO-ED1 period it was identified that there will be a need for the establishment of an additional connection points near Lesmahagow in Lanarkshire within RIIO-ED2 period.

SP Distribution submitted a ModApp for this new GSP to NGESO in January 2020. This new GSP was assessed and included in the RIIO-T2 plan and SPD received and accepted the NGESO offer in November 2020.

The primary driver for investment at Lesmahagow substation is to alleviate fault level constraints on the 33kV network at Linnmill GSP. The peak make fault level at Linnmill GSP 33kV switchboard exceed the network design limit and the RMS Break is above 95% of the design limit which would prevent connection of future generation, even small embedded 11kV generation as it would require a high-level cost for the fault level mitigation. Under design policy, the fault level mitigation is deemed necessary above 95% threshold.

There is also no capacity on the grid transformers to allow for any new generation connections, 187.6MW of connected generation against a non-firm grid transformer capacity of 180MVA. Distribution Future Energy Scenarios (DFES) data predicts a large increase in distributed generation

connecting at Linnmill GSP, with a range of 79-103MW of new generation potentially connected by the end of the RIIO-ED2 price control period. This volume of new connections would result in significant thermal issues at the Linnmill GSP grid transformers requiring substantial reinforcement work.

It is proposed to establish a new 132/33kV 60MVA GSP within the Lesmahagow region connecting into Coalburn 132kV transmission network.

The SP Distribution works for this solution involves the installation of a new indoor 33kV switchboard and 33kV circuits to connect to the new board. The costs of SPD works are included within the CV3 expenditure.

The SP Transmission works for this solution the installation of two 60MVA transformers, two 33kV incomer circuit breakers and associated cables. The full cost of transmission works will be charged to SP Distribution and funded through CV4 (TCPs new) upon the new GSP energisation. Based on the accepted ModApp offer, the connection date for Lesmahagow GSP is October 2027. In addition to this, there are also one-off costs required at this site which will be charged in 2025 and 2026.

The details of this scheme are detailed in the paper 'ED2-LRE-SPD-020-CV3-EJP – New Lesmahagow GSP' and a summary of new transmission capacity charges are shown in Table 4-9.

Table 4-9. Summary of CV4 expenditure for Lesmahagow GSP under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	-	-	-	-	-	**-**
TCPs new	-	-	0.058	0.159	0.583	**0.800**
Total	**-**	**-**	**0.058**	**0.159**	**0.583**	**0.800**

4.5 SPD: 33kV Switchboard Replacement at Whitehouse GSP

Whitehouse GSP has been identified as a candidate for load reinforcement during the RIIO-ED2 price control period due to the fault level issues. The peak make fault level at Whitehouse GSP 33kV switchboards is above 95% of the switchgear ratings which would prevent connection of future generation, even small embedded 11kV generation as it would require a high-level cost for the fault level mitigation. The peak make rating of this legacy switchgear is considerably lower than the 33kV peak make design limit of 50kA. Under design policy, the fault level mitigation is deemed necessary above 95% threshold. In addition, the peak make fault level can exceed 106% of the equipment rating under outages in the adjacent Kaimes GSP, when Whitehouse GSP is required to provide support to Kaimes. GSP

The proposal is to replace the existing indoor 33kV switchboards, 'A' and 'B' boards, with a new rationalised indoor 33kV board to resolve the fault level issue and provide headroom for future demand growth and connection of embedded generation.

The SP Distribution works for this solution involves the installation of nine distribution panels (eight of which are feeder breakers and a bus section) and associated environmental, engineering, civil. The costs of SPD works are included within the CV3 expenditure.

The SP Transmission works for this solution involves the installation of two incomer breakers which is included in the RIIO-T2 plan. The full cost of transmission works will be charged to SP Distribution and funded through CV4 (TCPs reinforced) upon 33kV switchboard energisation. SP Distribution will submit a ModApp to NGESO for these works in 2024/25 and it is envisaged that the works will be completed in 2025/26.

The details of this scheme are detailed in the paper 'ED2-LRE-SPD-015-CV3-EJP - Whitehouse GSP Fault Level Mitigation' and a summary of transmission capacity charges are shown in Table 4-10.

Table 4-10. Summary of CV4 expenditure for Whitehouse GSP under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	-	-	0.016	0.016	0.016	**0.047**
TCPs new	-	-	-	-	-	**-**
Total	**-**	**-**	**0.016**	**0.016**	**0.016**	**0.047**

4.6 SPD: RIIO-ED1/RIIO-T1 Projects

Following work carried out by SP Transmission during RIIO-T1 and our analysis during RIIO-ED1, a number of GSP sites were identified which required reinforcement to increase capacity and to resolve fault level issues.

At Cupar GSP both 60MVA grid transformers (GT1 and GT2) were replaced with 90MVA units in 2017. At Sighthill GSP one 120MVA grid transformer (GT1) was replaced with a 180MVA unit in 2016. At Strathleven GSP one 60MVA grid transformer (GT1) was replaced with a 90MVA unit in 2017. At Galashiels GSP both 45MVA grid transformers were replaced with 90MVA units, GT2 in 2017 and GT1 in 2018. No works were required by SP Distribution at any of these sites and new transmission capacity charges (TCPs reinforced) are applicable from 2016, 2017 and 2018 depending on the site. As these charges are over 40 years, they cover RIIO-ED2 period as well.

St Andrew's Cross GSP has been identified as approaching switchgear fault level limits and requires fault level reinforcement during the RIIO-ED1 price control. The peak make fault level at St. Andrews Cross GSP 33kV switchboards is approaching and predicted to exceed 95% of the switchgear ratings. This would prevent connection of future generation, even small embedded 11kV generation as it would require a high-level cost for the fault level mitigation. The rating of this legacy switchgear is considerably lower than the typical 33kV design limits. Under design policy, the fault level mitigation is deemed necessary above 95% threshold

The proposal is to replace the existing legacy rated 33kV switchboard with a new 33kV board to resolve the fault level issue and provide headroom for future demand growth and connection of embedded generation. The SP Distribution works for this solution involves the installation of 13 distribution panels (12 of which are feeder breakers and a bus section) and associated environmental, engineering, civil. The SP Transmission works for this solution involves the installation of two incomer breakers which is included in the RIIO-T2 plan. The full cost of transmission works will be charged to SP Distribution and funded through CV4 (TCPs reinforced) upon 33kV switchboard energisation.

Tongland GSP had an unconventional design as the two 132/11kV grid transformers feed two 11kV boards, one generation and another distribution. The outgoing 33kV feeders to the 33/11kV Primaries

at Castle Douglas, Dalbeatie and Gatehouse are achieved by four step-up 11/33kV transformers that are fed from the distribution board. The 30MVA 132/11kV transformers were reaching their thermal capacity limit and the GSP was required to be reinforced. A new 33kV GSP at Tongland substation was commissioned in 2019 to provide a system that is consistent with standard design and provide sufficient capacity and flexibility for the future. New transmission capacity charges (TCPs new) are applicable from 2019 and as these charges are over 40 years, they cover RIIO-ED2 period as well.

In addition, two 33kV switchboards were identified to be replaced due to the fault level issues in RIIO-ED1. These are 33kV boards at Portobello GSP and Dunfermline GSP. The SPD works for these boards are funded under CV3 allowance in RIIO-ED1 period and the capacity charges for two incomer circuit breakers will be funded through CV4 (TCPs reinforced) upon the energisation of the boards. Both Portobello and Dunfermline 33kV boards are scheduled to be complete in 2022.

A summary of CV4 charges for above projects is shown in Table 4-11.

Table 4-11. Summary of CV4 expenditure for RIIO-ED1/RIIO-T1 projects under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	1.114	1.111	1.093	1.079	1.065	**5.463**
TCPs new	0.697	0.685	0.674	0.665	0.657	**3.378**
Total	**1.811**	**1.796**	**1.767**	**1.745**	**1.722**	**8.841**

4.7 SPD: Customer Driven Projects

During RIIO-ED1 period, there are a few accepted generation customer connections which require significant works at transmission connection points before their connections. The transmission works at transmission connections assets are fully funded by the customers and therefore no capital charges will be payable by SP Distribution. SP Distribution would only cover site specific maintenance charges and transmission running costs of these assets over 40 years upon their energisation which will be funded through CV4 (TCPs reinforced).

In order to accommodate additional generation at Dunbar GSP, two additional 132/33kV 90MVA grid transformers and an additional 33kV 'B' switchboard were installed. The installation of transmission assets was fully funded by the generation customers and the installation of the new 'B' board was funded under CV3 allowance in RIIO-ED1 period. The new Dunbar 'B' GSP was fully energised in December 2020 and the maintenance and running costs are applicable from 2021. As these charges are over 40 years, they cover RIIO-ED2 period as well.

In order to accommodate additional generation at Westfield GSP, it is required to replace the existing 60MVA grid transformers with new 60MVA grid transformers of higher impedance such that the fault level infeed from the transmission network is reduced. The replacement of grid transformers will be fully funded by the generation customers and there is no works required by SP Distribution. The new transformers are forecast to be energised in 2022, so the maintenance and running costs will be applicable from 2023. As these charges are over 40 years, they cover RIIO-ED2 period as well.

In order to accommodate additional generation at Newton Stewart GSP, it is required to install a second 132/33kV 60MVA a grid transformer at Newton Stewart. The installation of this second grid transformer will be fully funded by the generation customers and there is no works required by SP

Distribution. The new transformer is forecast to be energised in 2023, so the maintenance and running costs will be applicable from 2024. As these charges are over 40 years, they cover RIIO-ED2 period as well.

A summary of maintenance and running costs at Dunbar GSP, Westfield GSP and Newton Stewart GSP is shown in Table 4-12.

Table 4-12. Summary of CV4 expenditure for customer driven projects under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	0.213	0.213	0.213	0.213	0.213	**1.063**
TCPs new	-	-	-	-	-	**-**
Total	**0.213**	**0.213**	**0.213**	**0.213**	**0.213**	**1.063**

4.8 SPM: Minor Modification to Layout of Legacy GSP

Legacy 400/132kV GSP is a key site in the SP Manweb distribution network supporting a major part of North Wales and feeding into Mid Wales and North Shropshire, supplying to ca. 143,600 customers in total.

This 132kV network group has experienced high levels of generation connections activity and has significant penetration of embedded generation with ca. 248MW of connected generation and an additional 130MW expected to connect within the RIIO-ED1 price control period. An additional 98MW generation is forecast to connect in the RIIO-ED2 period.

With growth of both demand and generation in this group and the adjacent Connah's Quay GSP group there is a requirement for increased operational flexibility within ED2. This requires minor modifications to the layout of the Legacy GSP substation to provide additional security to the group in the event of outages on the transmission network, and to provide additional operational flexibility to enable improved coupling with the adjacent Connah's Quay GSP.

The proposed transmission works include installation of an additional outdoor 132kV breaker and reconfiguration of cables connecting two NGET supergrid transformers.

The SPM works for this scheme will be funded under CV1 allowance in RIIO-ED2 period and the capacity charges for the transmission connection assets will be funded through CV4 (TCPs reinforced) upon completion.

SP Manweb will submit a ModApp to NGESO for these works in 2023 and it is envisaged that the works will be completed in 2025/26. In addition to this, there are also one-off costs required at this site which will be charged in 2024/25.

The details of this scheme are detailed in the paper 'ED2-LRE-SPM-030-CV1-EJP – Legacy 132kV Reinforcement' and a summary of transmission capacity charges are shown in Table 4-13.

Table 4-13. Summary of CV4 expenditure for Legacy GSP under RIIO-ED2, £m (2020/21 prices)

CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Costs
TCPs reinforced	-	1.550	0.009	0.009	0.009	**1.576**
TCPs new	-	-	-	-	-	**-**
Total	**-**	**1.550**	**0.009**	**0.009**	**0.009**	**1.576**

4.9 SPM: RIIO-ED1 Projects

There were no RIIO-ED1 projects in SPM which would trigger transmission capacity charges.

4.10 SPM: Customer Driven Projects

There are no customer driven projects in SPM which would trigger transmission capacity charges.

5 Deliverability & Risk

5.1 Preferred Options & Output Summary

The estimated total cost for the New Transmission Capacity Charges (CV4) is £22.232m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

£1.576m of SPM CV4 costs are covered in "ED2-LRE-SPM-030-CV1-EJP - Legacy 132kV Reinforcement" EJP, with no costs claimed in this EJP.

£2.534m of SPD CV4 costs are covered in four named scheme engineering justification papers (EJP) listed in Table 4-2, with **the remaining £18.123m claimed in this EJP**.

5.2 Cost & Volumes Profile

Table 5-1 shows the proposed volumes and the cost incidence (in 2020/21 prices) over the RIIO-ED2 period is shown in Table 5-2.

Table 5-1: Summary of volumes

Licence area	CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Volumes
SPD	TCPs reinforced – licensee requirement	4	5	2	-	-	**11**
	TCPs new – licensee requirement	-	-	1	-	1	**2**
SPM	TCPs reinforced – licensee requirement	-	-	1	-	-	**1**
	TCPs new – licensee requirement	-	-	-	-	-	**-**
Total		**4**	**5**	**4**	**-**	**1**	**14**

Table 5-2: Cost incidence over the RIIO-ED2 period, £m (2020/21 Prices)

Licence area	CV4 Category	2023/24	2024/25	2025/26	2026/27	2027/28	Total Volumes
SPD	TCPs reinforced – licensee requirement	2.196	3.199	3.501	3.462	3.422	**15.780**
	TCPs new – licensee requirement	0.697	0.685	0.967	1.057	1.470	**4.876**
SPM	TCPs reinforced – licensee requirement	-	1.550	0.009	0.009	0.009	**1.576**
	TCPs new – licensee requirement	-	-	-	-	-	**-**
Total CV4		**2.893**	**5.434**	**4.477**	**4.527**	**4.901**	**22.232**

5.3 Risks

The deliverability of the proposed RIIO-T2 schemes in sections 4.1, 4.3 and 4.4 depends on the completion of SPT works. If these works are delayed, operational restrictions will continue or will be imposed and there will be delay for the future connections.

5.4 Outputs Included in RIIO-ED1 Plans

Outputs included within the RIIO-ED1 period are explained in sections 4.6 and 4.7.

5.5 Future Pathways – Net Zero

5.5.1 Primary Economic Driver

The primary driver for this investment is insufficient thermal headroom, maximum short circuit rating of substation equipment being exceeded and security of supply risk at GSP sites.

Resolution of these constraints involves the relevant Transmission Network Operator. The investment does not have a strong reliance on environmental benefits.

5.5.2 Sensitivity to Future Pathways

Fault level schemes at six 275/33kV SPD sites described in section 4.1 are already breaching the fault level design limits and are necessary under all scenarios. These schemes are part of the SPT RIIO-T2 programme.

Projects included in section 4.6 have already been delivered and projects in section 4.7 are triggered by the customers and are being delivered in RIIO-ED1. Hence, these projects are not subject to future pathways.

The sensitivity to future pathways of other projects included in section 4 are included in the following papers:

- ED2-LRE-SPD-004-CV3-EJP – Currie GSP Fault Level Mitigation
- ED2-LRE-SPD-021-CV1-EJP – New Moffat GSP
- ED2-LRE-SPD-020-CV3-EJP – New Lesmahagow GSP
- ED2-LRE-SPD-015-CV3-EJP – Whitehouse GSP Fault Level Mitigation
- ED2-LRE-SPM-030-CV1-EJP – Legacy 132kV Reinforcement

5.5.3 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.

5.5.4 Losses / Sensitivity to Carbon Prices

Losses have been considered in accordance with License 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. Solution selection was not found to be sensitive to the impact of the carbon cost of losses.

Losses have been considered as part of this design solution and it has not been necessary to carry out any losses justified upgrades.

5.5.5 Whole Systems Benefits

Whole system solutions have been considered as part of this proposal.

5.6 Environment Consideration

5.6.1 Operational and embodied carbon emissions

The proposed new transmission capacity charges which cover projects to be carried out by transmission licensees at transmission connection points or for new transmission connection points have the potential to result in embodied carbon from the delivery of interventions required. The projects include the replacement and installation of new transformers. However, the projects have limited potential to impact on SPEN's overall Business Carbon Footprint (BCF).

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

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

5.6.2 Supply chain sustainability

For us to take full account of the sustainability impacts associated of the new transmission capacity charges projects, 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.

5.6.3 Resource use and waste

New transmission capacity charges projects 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).

Retrofitting and refurbishment of existing assets will reduce the amount of resources required and waste materials generated relative to replacement with new assets. The environmental benefits of reduced resource consumption and waste generation will be balanced against our operational requirements and other environmental impacts such as associated carbon emissions and the impact of oil spills from transformers on the surrounding environment.

5.6.4 Biodiversity/ natural capital

The new transmission capacity charges projects will only affect sites containing existing assets. Therefore, the impact on, and the opportunity to improve biodiversity and natural capital is expected to be minimal.

5.6.5 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.

5.6.6 Visual amenity

SPEN continually seeks to reduce the landscape and visual effects of our networks and assets. The proposed interventions at existing sites are not likely to generate any additional impact in relation to visual amenity.

5.6.7 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. In particular, the increased threat of flooding (pluvial, fluvial or from sea level rise) to our substations is a key risk that we manage according to a specific policy document governing Substation Flood Resilience Policy.

Additionally, we are actively working with suppliers to improve the resilience of transformers and other assets to extreme weather events (including storms, heatwaves and spells of very cold weather)

and to higher year-round temperatures. We have also modified our policy on vegetation control in the face of higher temperatures and longer growing seasons.

6 Conclusion

Distributed generation growth and Low Carbon Technologies (LCT) uptake is expected to continue and indeed accelerate as UK generation decentralises to meet Net Zero targets. Due to high level of predicted demand and generation, the collaborative approach between distribution and transmission is needed to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solution is selected.

This engineering justification paper proposes the investment for the new transmission capacity charges. Within SPD, our analysis indicated that several sites would require a fault level mitigation from SPT side and there will be a need for additional connection points in RIIO-ED2. We have worked collaboratively with SP Transmission to ensure the best whole electricity system is considered and an economic, co-ordinated and efficient solutions are selected. Within SPM, our analysis indicated that one GSP will require works on the NGET side to increase operational flexibility within RIIO-ED2.

The estimated total cost for the New Transmission Capacity Charges (CV4) is £22.232m (in 2020/21 prices) with 100% contribution to be included in the RIIO-ED2 load related expenditure.

£2.534m of SPD CV4 costs are covered in four named scheme engineering justification papers (EJP) listed in Table 4-2, with the remaining £18.123m claimed in this EJP.

£1.576m of SPM CV4 costs are covered in "ED2-LRE-SPM-030-CV1-EJP - Legacy 132kV Reinforcement" EJP, with no costs claimed in this EJP.