

RESILIENCE – PERSONNEL COMMUNICATIONS ENGINEERING JUSTIFICATION PAPER

RIIO-ED2



Scottish & Southern
Electricity Networks

1. SUMMARY TABLE

Summary table for OTN Rollout			
Name of Scheme/Programme	Resilience – Personnel Communications		
Primary Investment Driver	BT21CN		
Scheme reference/ mechanism or category	419/SSEPD/OT/PERSONNEL_COMMS		
Output references/type			
Cost	£5.59m		
Delivery Year	2023/24/25		
Reporting Table	CV12		
Outputs included in RIIO ED1 Business Plan	No		
Spend apportionment	ED1	ED2	ED3+
		£5.59m	

EXECUTIVE SUMMARY

This paper relates to the provision of telephony and radio communications for our distribution substations and key operational staff, for both routine and emergency situations.

Communication between our staff is essential for safe and secure network operations; between substations, our control centre and staff on the ground at any location and at all times.

This ability is currently provided by traditional public switched telephone network (PSTN) telephony, provided by BT over copper circuits, supported in some areas by Voice over Internet Protocol (VoIP) and Personal Mobile Radios (PMRs). BT have committed to withdrawing the PSTN by 2025 and alternative means of communication is required.

This will be delivered through the implementation of:



	SHEPD	SEPD
 Personal/Portable PMRs and associated training	25	110
 Fixed PMRs	19	254
 VOIP across OTN	30	40
 VOIP across Openreach's 'Fibre to Premises' or other resilient 3rd party Networks	40	50
Total Cost:	£1.81m	£3.78m

This will ensure our ability to operate not only for business as usual but also in the event of a major system breakdown or black start. This project will be delivered within the RIIO-ED2 period (by 31st December 2025) and is required to ensure the ongoing resilience of our distribution network.

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4. INTRODUCTION

This Engineering Justification Paper sets out our plans to enhance personnel communications during the RIIO-ED2 period.

The Engineering Justification Paper is structured as follows:

Section 4: Need

This section provides an explanation of the need for the planned works. It provides evidence of the primary and, where applicable, secondary drivers for undertaking the planned works. Where appropriate it provides background information and/or process outputs that generate or support the “need”.

Section 5: Optioneering

This section presents all the options considered to address the “need” that is described in Section 3. Each option considered here is either discounted at this optioneering stage with supporting reasoning provided or is taken forward for Detailed Analysis in Section 5.

Section 6: Detailed Analysis

This section considers in more detail each of the options taken forward from the Optioneering section. Where appropriate the results of Cost Benefit Analysis are discussed and together with supporting objective and engineering judgement contribute toward the identification of a selected option. The section continues by setting out the costs for the selected option.

Section 7: Conclusion

This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

5. NEED

Communication between staff and sites is essential for the safe operation of the network. This includes between the control centres and substations, substations to staff on the ground at any location across the network. This is especially true when acting in response to faults or more severe region wide disruption including a black start event.

5.1 REDUNDANCY

Mobile telephony and wireless data gives tools to the public and business that allow communication and sharing of data from anywhere within range of a base station. An essential component of the base stations is the electricity that powers them. The majority of base stations are not designed with resilience in mind and will be unavailable either immediately, or very shortly after, an electricity network outage or disruption. As an operator responsible for “keeping the lights on”, we can make use of these technologies to improve business performance but cannot rely on them solely to continuing operating during a network event.

5.2 NETWORK OBSOLESCENCE

Most substation sites utilise traditional public switched telephone network (PSTN) telephony, provided by BT over copper circuits. This has given high levels of power resilience as the PSTN network is designed to continue operating during electrical outages over several days. BT have issued a cease notice on the PSTN product and it is due to be decommissioned by end 2025. As a result of this an alternative solution is required to provide resilient communications.

5.3 PRIVATE MOBILE RADIO (PMR)

We already own and operate our own PMR network. This radio network has been designed as a fall-back communications system for both fixed sites and field staff. The system is autonomous for a minimum of 72 hours without electricity supplies and is air-gapped from all other SSE systems. This provides increased security preventing a single cyber-attack from disabling all personnel communication routes.

In 2013, we experienced widespread storms and severe line icing which interrupted supplies across the Argyll area for a duration of several days. The PMR system remained operational throughout, allowing for a co-ordinated and efficient response in restoring power to customers. Other more routine communication methods such as mobile telephony failed rapidly due to loss of power supplies, and indeed the PMR system proved to be more resilient than the fall-back communications used by other agencies including the emergency services. This experience proves the potential benefits, should a similar or black start event occur in future.

5.4 VOIP TECHNOLOGY

Newly built or refurbished substations have Voice-over-IP (VoIP) telephony delivered through the SSE Group corporate IT network. This provides modern & effective communications links into the corporate network, but it does have disadvantages.

In terms of resilience VoIP services are dependent on supplies at the end-point (i.e. the phone itself) plus the servers used for operating the system. The central corporate IT infrastructure is not designed to operate without power over the length of times that could be experienced during a UK wide black start event, which could result in a loss of site communications. Improving this centrally would be a costly solution as these servers operate for the entire SSE Group, a system several times larger than that required for essential operations.

The corporate VoIP service is interconnected to the corporate IT network and there is a risk that a cyber-attack on the corporate network could compromise VoIP telephony and disrupt communications. The Operational Technology Network is designed to be more secure than the corporate network, and there is a plan to build a standalone system within the Operational Technology Network (OTN) (422/SSEPD/OT/OT2_OTN_ROLLOUT). This is more cost-effective than attempting to improve the security and power resilience across the entire corporate network. The control system is designed to cope with loss of power and is hardened to cyber-attack to allow us to continue operating without the corporate IT network. The corporate VoIP system does not fit within that business continuity plan.

5.5 REMOTE COMMUNICATIONS DURING NETWORK EVENTS

During a network event, mobile phone base stations may suffer from a loss of supply and communications networks will not be accessible. During severe weather events, the majority operational work is on overhead lines and staff cannot utilise VoIP within substations. An alternative means of communications is required for operational staff outside the substation environment.

6. OPTIONEERING

This section presents the options considered to address the “need” that is described in Section 3. Each option considered here is either discounted at this Optioneering stage with supporting reasoning provided or is taken forward for detailed analysis in Section 5.

“Do Nothing” would leave us with limited capability to communicate with our field staff during a black-start scenario following the PSTN switch-off. Doing nothing is therefore not considered an option.

- Minimum Requirement
 - The bare minimum required to “keep the lights on” & maintain legal/regulatory compliance
- Responsible Operator
 - A more resilient network for longer term customer benefit
 - An adaptable, sustainable and flexible network providing enhanced value to current and future customers
- Gold Standard
 - A resilient network with fixed link communication available at all substation with PMR for engineering works in the field

In this workstream, “Minimum Requirement”, “Responsible Operator” and “Gold Standard” options are considered.

The scope, risks and benefits of each of these is laid out below.

6.1 MINIMUM REQUIREMENT

This solution meets the minimum requirement of maintaining communications with engineering teams in the field through the use mobile PMR handsets. There are also key sites and sites where the PMR signal is weak where a PMR with a fixed antenna will be installed. The key sites are staging sites for black start where operational technology staff and other key engineering staff will gather as part of black start business continuity procedures.

This option will entail continued reliance on existing PSTN circuits, which will not be available after 2025. If no action was taken in this area over the course of RIIO-ED2, it would significantly limit the ability to communicate with operational staff in the field during system events.

The main mode of communication will be using PMR handsets whose number will need increased as PSTN lines become unavailable and we ensure key personnel have access to communications. Additional base stations to increase the coverage of the PMR would also be required.

This solution would provide limited reliability for communication within substation buildings where the majority of work takes place

This option has been progressed to Detailed Analysis.

6.2 RESPONSIBLE OPERATOR

The 'Responsible Operator' option addresses the need to provide resilient communications for operational staff when in the field, through the provision of Portable Mobile Radios (PMRs) and within substations through the provision of a mix of VOIP across the OTN and across other resilient 3rd party infrastructure, and fixed PMR at sites where coverage exists. This option supports the provision of resilient communications within the substation where handheld PMRs are unlikely to get a signal.

No works would be undertaken at sites where resilience is presently provided via VOIP on the SSE Corporate Network.

Key operational staff, including those needed for Black Start restoration have been identified, and will be provided with a personal PMR handsets. Fixed PMRs will be installed in all substations with coverage which do not have an alternative resilient communications route. Fixed PMRs have better antennae and are proven to work in substations to ensure coverage while working indoors, as well as giving PMR access to other staff working on site.

On this basis, this option has been progressed to Detailed Analysis.

A summary of the above optioneering is shown in Table 1, below.

6.3 GOLD STANDARD

The gold standard of personal communications is to have the communications at all the substations on fixed links VOIP across the OTN alongside an expanded PMR network to give coverage in the field.

The execution of this option will be problematic within time frame of ED2. Fixed links installed into all substations would present a number of issues specifically wayleaves and easements which can take months if not years to resolve

This option would deliver resilient fixed link communication using VOIP at all substation sites that cannot be affected by interference and is backed up by the availability of the PMR network.

On this basis, this option has been progressed to Detailed Analysis.

PROGRESSED TO DETAILED ANALYSIS

A summary of the above optioneering is shown in Table 1, below.

	Do Nothing	Minimum Requirements	Responsible Operator	Gold Standard
Remove reliance on PSTN system	✗	✓	✓	✓
Use of VOTN and VoIP on other Networks	✗	✗	✓	✓
PMR coverage at substations	✗	✗	✓	✓
Full staff PMR coverage	✗	✗	✓	✓
Partial Black start capability	✗	✓	✓	✓
Full black start capability	✗	✗	✓	✓

Table 1 - Optioneering Summary

7. DETAILED ANALYSIS

This section considers in more detail each of the options taken forward from the Optioneering section. It examines three comparative factors in order to determine the preferred option:

- Risk,
- Stakeholder Requirements and
- Cost.

7.1 RISK AND BENEFIT ANALYSIS

Due to the nature of this project, risks and benefits involved are not easily quantifiable and are not suitable for traditional Cost Benefit Analysis.

Risk ID	Risk Title	Risk	Unmitigated Overall Risk Rating	Minimum Requirements	Responsible Operator	Gold Standard
				Mitigated Overall Risk Rating	Mitigated Overall Risk Rating	Mitigated Overall Risk Rating
1	PTSN Withdrawal	BT plan to withdraw PTSN by 2025	Severe	High	Medium	Medium
2	Network Events	Loss of Personnel communication during network event would not allow us to communicate with staff at remote locations	Severe	Severe	Medium	Low
3	VoIP Technology - Black Start	IT infrastructure is not designed to operate without power over the length of times that could be experienced during a UK wide black start event, which could result in a loss of site communications	Severe	High	Low	Low
4	VoIP technology - Cyber Security	Any attack on the corporate IT network could interfere with VoIP telephony and disrupt communications with sites	Severe	Medium	Medium	Low
OVERALL			Severe	High	Medium	Low

Table 2 – Risk Analysis

In order to assess the options for delivering this project, a Risk Analysis was carried out. For each option taken forward to Detailed Analysis, it looks at the existing risks, the likelihood of these risks being realised, and the severity should that happen. The likelihood and severity combine to give an overall Unmitigated Risk Rating.

Mitigation actions delivered by each option are then identified, and the likelihood and severity are reappraised, resulting in a Mitigated Risk Rating.

The Unmitigated Risk Rating is “Severe”. Once all the mitigations are taken into account, the Mitigated Risk Rating falls to “High” for Minimum Requirements and “Medium” for the Responsible Operator Option. Therefore, there is some additional risk benefit is delivered by the Responsible Operator option. The gold standard solution would reduce risk to its lowest possible level.

7.2 COSTS – MINIMUM REQUIREMENTS

Costs for this option based on standard rates are £1.02m for SHEPD and £2.20m for SEPD over the course of the RIIO-ED2 price control, as shown in Table 3.1 and 3.2.

SHEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	50	£25,000
Fixed PMR	£7,130	64	£456,320
PMR Infrastructure	£7,040	20	£140,800
PMR Base stations	£79,420	5	£397,100
Total Cost			£1,019,220
Total Cost (£k)			£1019.22

Table 2.1 - Costs for Minimum Requirements Option-North

SEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	214	£107,000
Fixed PMR	£7,130	240	£1,711,200
PMR Infrastructure	£7,040	20	£140,800
PMR Base stations	£79,420	3	£238,260
Total Cost			£2,197,260
Total Cost (£k)			£2197.26

Table 3.2 - Costs for Minimum Requirements Option-South

7.3 COSTS - RESPONSIBLE OPERATOR

Costs for this option based on standard rates are £1.81m for SHEPD and £3.78m for SEPD over the course of the RII0-ED2 price control, as shown in Table 4. It is understood there will be no additional service costs when expanding the number of PMRs as this service contract covers the existing infrastructure which would still be utilised for communication. There will be additional service costs for 3rd party connectivity for VOIP

SHEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	25	£12,500
Fixed PMR	£7,130	19	£135,470
PMR Infrastructure	£7,040	20	£140,800
PMR Base stations	£79,420	5	£397,100
VOIP(OTN)	£680	30	£20,400
VOTN (infrastructure)	£100,140	1	£100,140
VOIP (No OTN)	£25,000	40	£1,000,000
Total Cost			£1,806,410
Total Cost (£k)			£1806.41

Table 4.1 – Costs for Responsible Operator Option -North

SEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	110	£55,000
Fixed PMR	£7,130	254	£1,811,020
PMR Infrastructure	£7,040	20	£140,800
PMR Base stations	£79,420	5	£397,100
VOIP(OTN)	£680	40	£27,200
VOTN (infrastructure)	£100,140	1	£100,140
VOIP (No OTN)	£25,000	50	£1,250,000
Total Cost			£3,781,260
Total Cost (£k)			£3781.26

Table 5.2 – Costs for Responsible Operator Option -South

7.4 COSTS-GOLD STANDARD

Costs for this option based on standard rates are £2.37m for SHEPD and £8.42m for SEPD over the course of the RIIO-ED2 price control, as shown in table 5. It is understood there will be no additional service costs when expanding the number of PMRs as this service contract covers the existing infrastructure which would still be utilised for communication. There will be additional service costs for 3rd party connectivity for VOIP

SHEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	10	£5,000
PMR Base stations	£79,420	5	£397,100
VOIP(OTN)	£680	30	£20,400
VOTN (infrastructure)	£100,140	1	£100,140
VOIP (No OTN)	£25,000	74	£1,850,000
Total Cost			£2,372,640
Total Cost (£k)			£2372.64

Table 5.1 – Costs for Gold Standard Option -North

SEPD

Solution	Unit Cost	Quantity	Cost
Personal/Portable PMR	£500	100	£50,000
PMR Base stations	£79,420	5	£397,100
VOIP(OTN)	£680	40	£27,200
VOTN (infrastructure)	£100,140	1	£100,140
VOIP (No OTN)	£25,000	314	£7,850,000
Total Cost			£8,424,440
Total Cost (£k)			£8424.44

Table 5.2 – Costs for Gold Standard Option -North

7.5 Proposed Solution

The options in terms of three comparative factors have been examined:

- Cost,
- Risk Reduction and
- Stakeholder Requirements.

We propose to undertake the Responsible Operator option, as it achieves an acceptable level of risk at the lowest cost. The Responsible Operator option ensures resilient communications are available when needed within substations. The gold standard has been discounted as there are doubts that this could be delivered within the ED2 period and it is felt that that our needs can met by the Responsible Operator option without the additional cost of the Gold standard option.

8. CONCLUSION

Communicating with operational staff is vital to the safe operation of the network. It enables coordinated responses to emergency events and provide consumers with a more effective service. The withdrawal of the existing PTSN requires the deployment of a diverse and resilient communications system.

An optioneering assessment took place which investigated two options, both of which were taken forward for detailed analysis.

Taking account of that detailed analysis, the preferred option is the 'Responsible Operator' option, which will deliver:

SHEPD

- 25 Personal/Portable PMRs and associated training.
- 19 Fixed PMRs
- 30 VOIP across OTN
- 40 VOIP across Openreach's 'Fibre to Premises' or other resilient 3rd party Networks
- PMR and VOIP Infrastructure to support the above

Cost: £1.81m

SEPD

- 110 Personal/Portable PMRs and associated training.
- 254 Fixed PMRs
- 40 VOIP across OTN
- 50 VOIP across Openreach's 'Fibre to Premises' or other resilient 3rd party Networks
- PMR and VOIP Infrastructure to support the above

Cost: £3.78m

9. APPENDIX A – PSTN LINE REPLACEMENT

Please see below for a summary of the PSTN line/Sites requiring replacement, the site detail is available upon request.

Business Directorate	PSTN Lines to be replaced	PSTN Lines to be replaced by OTN Roll Out programme before PSTN switch off (Dec 2025)	PSTN Lines to be replaced by Resilience/Personnel Communications Programme
SHEPD	155	41	114
SEPD	563	109	454
Total	718	150	568

10. APPENDIX B – DETAILED SOLUTION PRICING

Please see below for a detailed breakdown of the personal communication solutions. Quotes/Evidence for the below pricing is available upon request.

Personal/Portable PMR

Description	Unit Cost
Simoco SRP9180 hand portable radio with battery antenna and 12V in car battery charger, programmed.	£ [REDACTED]
Total Cost	£ [REDACTED]
Total Cost (rounded to the nearest £10)	£ [REDACTED]

Fixed PMR

Description	Unit Cost
Simoco desk top 'fixed mobile' radio comprising: <ul style="list-style-type: none"> • Simoco Mobile radio, speaker, Mic, DC lead • Desk Mount enclosure • 48V to 12V DC-DC convertor • Ground plane antenna, 5m aluminium stub mast, channel brackets, U bolts, Wall bolts. 10m cable, connectors. • Assemble, program, on-site installation. 	£ [REDACTED]
Simoco Project Management, arrangements, RAMS, etc	£ [REDACTED]
PMR Radio Survey/site	£ [REDACTED]
OTN Site / Building Survey Form/site	£ [REDACTED]
Pre-Install Work, including tray work, DC Supply, Antenna prep and earthing.	£ [REDACTED]
OSR Close Supervision of SIMOCO engineers during PMR installation. Including SAPs on sites where required.	£ [REDACTED]
Supply of Scaffold and build to enable antenna installation.	£ [REDACTED]
Install Antenna/Equip	£ [REDACTED]
Total Cost	£7,132
Total Cost (rounded to the nearest £10)	£7,130

PMR Infrastructure

Description	Unit Cost
Xfin Blade 50W DC Power With Multi-site software	£ [REDACTED]
50W Internal 48V PSU	£ [REDACTED]
Band Pass Duplexer	£ [REDACTED]
Rf, Network & Other Cables	£ [REDACTED]
DC Cabling Leads	£ [REDACTED]
Rack Hardware for other Units	£ [REDACTED]
Shelf Supports	£ [REDACTED]
Rack Build and Test	£ [REDACTED]
Installation Services	£ [REDACTED]
Total Cost	£7,043
Total Cost (rounded to the nearest £10)	£7,040

PMR Base Station

Description	Unit Cost
First Pass Radio Design, LOS Eng Surveys & PM	£ [REDACTED]
Final Design / Ofcom	£ [REDACTED]
ALCplus IDU (1+1) 50Mbps Physical interfaces: 3xFE/GE + 32xE1 Ethernet Capacity: 50Mbps Modulation / Channel Spacing: 4QAM / 28MHz channels	£ [REDACTED]
18 GHZ ASN ODU Ruggedised	£ [REDACTED]
Price for IDU with micro coaxial connectors.	£ [REDACTED]
Price for IDU 16E1 + 3x10/100BaseT Ethernet Interface	£ [REDACTED]
Price for IF loop.	£ [REDACTED]

Not-Integrated antenna pole mounting kit 1+1 hot stand-by on one antenna system.	£ [REDACTED]
Solar shield.	£ [REDACTED]
Flexible coaxial tails for 1+1 IDU	£ [REDACTED]
N male connector for 1/2" coaxial cable	£ [REDACTED]
Earthing kit 1/2" coaxial cable	£ [REDACTED]
N Type Surge Arrestor	£ [REDACTED]
Coaxial DDF Frame and Blocks 16xE1, per end	£ [REDACTED]
SCSI Connector to 8xE1 Type 43 coaxial trib assembly (2m)	£ [REDACTED]
Alarm and Power supply Connectors kit for 1+1 IDU	£ [REDACTED]
0.3m Antenna (no bracing bars)	£ [REDACTED]
1/2" LDF 4-50 CABLE (Uplift per 150m)	£ [REDACTED]
Antenna Ruggedisation	£ [REDACTED]
Pole Mounting Kit Ruggedisation	£ [REDACTED]
Installation	£ [REDACTED]
Project Management – Microwave Build Contractor	£ [REDACTED]
Waveguide / dehydrator Hardware	£ [REDACTED]
Waveguide / dehydrator Installation	£ [REDACTED]
Steelwork	£ [REDACTED]
Build Contractor Project Management	£ [REDACTED]
Site Sharing Costs	£ [REDACTED]
Connection Master	£ [REDACTED]
DC Rail	£ [REDACTED]
Equipment Rack	£ [REDACTED]
DC Power Supply	£ [REDACTED]

Installation Charge for Racks, Cabling, Din Rails, Fuse Holders and DC Systems Man Days	£ [REDACTED]
Total Cost	£79,423
Total Cost (rounded to the nearest £10)	£79,420

VOIP (OTN)

Description	Unit Cost
VOIP Phone	£ [REDACTED]
Cabling	£ [REDACTED]
Installation and Professional Services	£ [REDACTED]
Total Cost	£684
Total Cost (rounded to the nearest £10)	£680

VOTN (Infrastructure)

Description	Unit Cost
Design	£ [REDACTED]
Mitel 3300MXe Server, Cards and power supplies	£ [REDACTED]
Cisco POE Switches	£ [REDACTED]
Associated Licenses	£ [REDACTED]
Software	£ [REDACTED]
Installation and Professional Services	£ [REDACTED]
Total Cost	£100,142
Total Cost (rounded to the nearest £10)	£100,140

VOIP (No OTN)

Description	Unit Cost
Design	£ [REDACTED]
Circuit Installation	£ [REDACTED]
Excess Construction Charges	£ [REDACTED]
VOIP Phone and Licenses	£ [REDACTED]
Cabling	£ [REDACTED]
Installation and Professional Services	£ [REDACTED]
Total Cost	£25,004
Total Cost (rounded to the nearest £10)	£25,000