Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan T2BP-EJP-0006

Transmission Communications Upgrade

Engineering Justification Paper

FINAL

1 Executive Summary

This Engineering Justification paper sets out the need for a reinforcement of our existing Communications network. Significant increases in the quantity of system data required, a rise in the volume of asset and network monitoring being undertaken to obtain this data and the growth of IP-based technologies all necessitate the installation of upgraded telecoms infrastructure to provide secure, resilient, dual and diverse fibre optic connections to all substations.

This proposal received strong support from our Stakeholders at a Stakeholder Engagement Workshop which took place on the 5th of March 2019 at the International Conference Centre in Edinburgh.

SHE Transmission has outlined the following deliverables for this approach;

- Upgrade to a fibre optic communications medium on the replacement / refurbishment of existing protection and control systems.
- Completing a full, dual, diverse fibre network to all Transmission substations with interconnections to adjoining Transmission Operators.
- Install secure data network connections into all Transmission substations complete with cyber security devices.

This preferred option is estimated to cost £31.10m. This above cost is based on previous expenditure for similar tasks and would be delivered as an ongoing roll-out of project works throughout the T2 period (2021 to 2026).

Upon project delivery there are several benefits relating to the RIIO-T2 business goals which have been listed below:

- A secure, resilient backbone for the transmission communications network in the long term and forms the basis to remotely access various plant and system monitoring elements to support our long-term Asset Management Strategy. Both are key contributors for delivering or goal to "aim for 100% Transmission network reliability for homes and businesses" stated in the "Network for Net Zero" Business plan.
- Provides high speed and high bandwidth data connections to each SHE Transmission substation site which enables and accelerates the drive towards eventual protection over IP and the wider digital substation strategy. This helps to achieve the goal of "£100 million in efficiency savings from innovation" outlined in the "Network for Net Zero" business plan.

Additionally, this will enable alignment with the recommendations from the Energy Data Taskforce report which sets an expectation that we digitise our network. We need to install high speed, high bandwidth data connections to facilitate this digitisation. This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

Name of Scheme/Programme	Transmission Communications Upgrade
Primary Investment Driver	Resilience
Scheme reference/ mechanism or category	SHNLT2038
Output references/type	NLRT2SH2038
Cost	£31.10m
Delivery Year	2021 - 2026
Reporting Table	C2.25
Outputs included in RIIO T1 Business Plan	No

2 Introduction

This Engineering Justification Paper sets out our plans to undertake Transmission Communication upgrades work during the RIIO-T2 period (April 2021 to March 2026).

The Engineering Justification Paper is structured as follows:

Section 3: 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 4: 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 5: 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 6: 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.

Section 7: Price Control Deliverables and Ring Fencing

This section provides a view of whether the proposed scheme should be ring-fenced or subject to other funding mechanisms.

Section 8: Outputs included in RIIO-T1 Business Plan

This section identifies if some or all the outputs were included in the RIIO-T1 Business Plan and provides explanation and justification as to why such outputs are planned to be undertaken in the RIIO-T2 period.

Section 9: References

3 Need

As part of the transition to the low carbon economy, four societal shifts are changing the way we operate our network: Decarbonisation, Decentralisation, Digitisation and Democratisation. Digitisation is the use of new Information Communications Technology and analytical tools to improve our performance without increasing costs. It enables a more dynamic and intelligent network and offers improvements in efficiency and resilience.

3.1 Increased Digitisation

Our network is undergoing significant changes in both the quantity of system data available and the way that information is collated, with increasing levels of data capture and transfer for both existing and new power system monitoring, and Internet Protocol based networks equipment to support the various dependent functions shown in Figure 1.

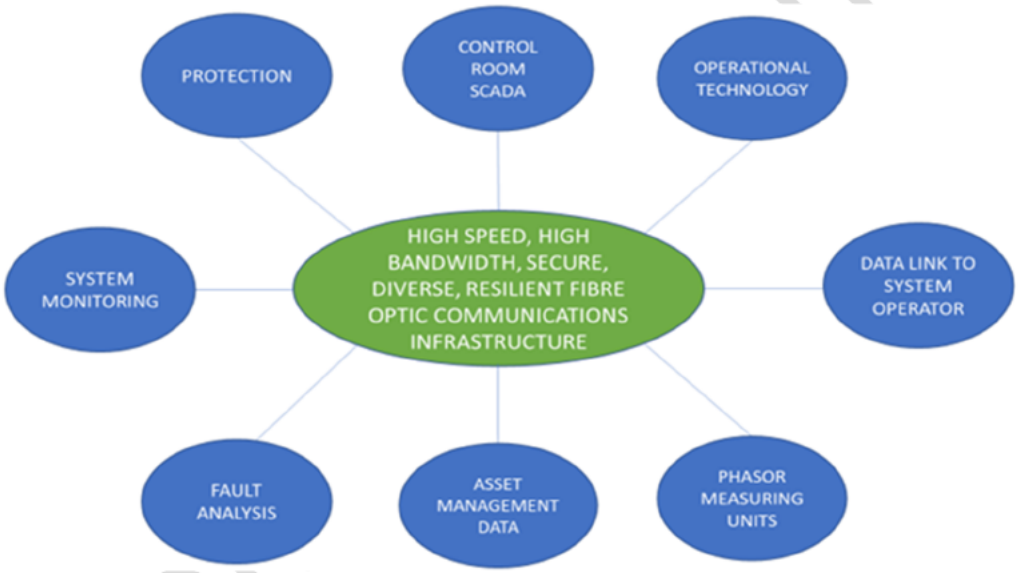


Figure 1 - Communications Hub Diagram

New procedures agreed with the System Operator and the modernisation of our protection systems are placing a significant and increasing demand on information transfer capacity. To fully support this digitisation, we require a communications network which is high speed, high bandwidth, secure and resilient to ensure the integrity of protection, control and monitoring of the transmission system.

3.2 Interdependencies

The works identified in this paper are interlinked with and are critical to the following programmes of work:

- Protection Modernisation (T2BP-EJP-0005), required to meet STCP 27-01 implementation which will allow the substation to provide real-time and post events monitoring for the System operator.
- SCADA Upgrades (T2BP-EJP-0007), which intends to develop each substation in its target list to become enhanced with the latest cyber security and operate in line with the IEC 61850 Standard, A communications protocol for intelligent electronic devices that requires fibre network connections inside substations.
- Integrated Condition & Performance Monitoring (T2BP-EJP-0012), which outlines the work required to allow real time monitoring of asset condition and performance to enable improved decision making and investment planning.
- [redacted]
- Personnel Communications (T2BP-EJP-0009), which outlines the requirement for the implementation of a Voice over Operational Technology Network (VoTN).

Successful implementation of these projects is dependent on the provision of the resilient communication channels between our assets, operational technology and our control facilities.

4 Optioneering

When reviewing our options in this area, we produced a three-tier approach to our development, in addition to a "Do Nothing" option:

- ***Minimum Requirements***
    - The bare minimum required to "keep the lights on" & maintain legal/regulatory compliance
- ***Responsible Operator***
    - A more resilient network for longer term customer benefit
- ***Progressive Network Enabler***
    - An adaptable, sustainable and flexible network providing enhanced value to current and future customers

4.1 Do Nothing

This option would entail no reinforcement of our Operational Communications Network over the course of RIIO-T2, even where other capital works were being carried out. This does not address any of the following concerns:

- No improvement to the resilience of the communications network, as microwave radio and other wireless options can be affected by atmospheric or adverse meteorological conditions.
- Additional Operational Technology (OT), and IP connectivity which would support asset and system monitoring would not be enabled due to a lack of network bandwidth being available.
- Does not support interdependent projects
- Does not allow us to comply with STCP 27-01

On this basis, this option has not been progressed to detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.2 Minimum Requirements

This option would replace earth wire with OPGW when other coincident works are being undertaken. Over a prolonged period beyond that of RIIO-T2, this would close the gaps in the fibre communications network.

During this timeframe, it would only be planned to maintain or repair/replace existing microwave or radio circuits where necessary.

Whilst this would be the lowest cost option, it does not address the following concerns:

- No improvement to the resilience of the communications network, as microwave radio and other wireless options can be affected by atmospheric or adverse meteorological conditions.
- Additional Operational Technology (OT), and IP connectivity which would support asset and system monitoring would not be enabled due to a lack of network bandwidth being available.
- Does not support interdependent projects
- Does not allow us to comply with STCP 27-01

On this basis, this option has not been progressed to detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

4.3 Responsible Operator

As a Responsible Operator, we would propose to continue the process of completing a full, dual, diverse fibre network to all Transmission substations on the SHE Transmission system, with interconnections to adjoining Transmission Operators using the most cost effective medium to ensure a secure resilient communications platform for system protection and SCADA.

Our approach is to utilise a fibre optic communications medium on all new protection and control systems, and to upgrade to a fibre optic communications medium on the replacement / refurbishment of existing protection and control systems, preferably using Optical Ground Wire (OPGW), fibre optic cables contained within the overhead line earth wire, and an inherent part of the Transmission network.

Fibre optic cable provides the most effective communications medium for use of digital protection and control systems in terms of dependability, security, speed, and simplicity, as it offers significantly higher reliability and higher bandwidth than microwave radio or other wireless alternatives. Fibre optic communications mediums are also affected much less by environmental factors including rain and snow, significantly reducing the risk of communications loss.

Fibre optic cable also offers a significantly higher bandwidth than buried copper cables and are immune to electromagnetic interference common in noisy environments, e.g. Substations and Overhead lines. They are also significantly more reliable as they are immune to temperature changes, adverse weather conditions and moisture ingress, all of which generally affect buried copper cables. Fibre optic cables can be constructed with no metallic elements eliminating interference and protecting against damage due to power surges.

This work would entail the installation of 410km of OPGW connecting 18 sites, and the installation of Multiplexers at 66 sites. Multiplexers are used to package data from several inputs and combine it into one output for transfer. They are used to increase the amount of data that can be sent over a network. Details of the work required is laid out in Appendix A.

Whilst this option provides the secure, resilient backbone for the transmission communications network required in the medium and long term, it does not offer scope for upgrading substations to facilitate their own networks.

On this basis, this option has been progressed to detailed analysis.

PROGRESS TO DETAILED ANALYSIS

4.4 Progressive Network Enabler

A key deliverable of this project is to support the increasing levels of data capture and transfer for both existing and new power system monitoring equipment and the resultant higher demand on information transfer capacity, whilst also taking into account the rise of Internet Protocol (IP) based networks. Therefore, in addition to the completion of a full dual, diverse fibre optic communications network, this option includes the installation of secure data network connections (DCNs) into all Transmission substations.

[redacted]

In addition to the works described in Section 4.3, this option would also include the installation of onsite network stacks, corporate network stacks, wiring and site racks at 69 sites, and the installation of security interface devices and DCN management devices at 75 sites.

The ability to remotely access system fault recording, power quality instruments and plant monitoring, will enable fast, post fault analysis to identify root cause of failures, as well as ongoing analysis of system data and plant performance to identify best deployment of maintenance resources subsequently reducing unplanned outage time. This will allow us to comply fully with STCP 27-01 by enabling the remote access to various plant and system monitoring elements to support the long-term Asset Management strategy. In addition, the provision of high speed and high bandwidth data connections to each SHE Transmission substation site would enable and accelerate the drive towards eventual protection over IP and the wider digital substation strategy.

This option addresses all the concerns laid out in Section 3. However, it does introduce the following concern:

- External IP connection to substations raises the risk of cyber security issues however, the connections would be routed via a secure network with the above cyber security proposal improving this.

On this basis, this option has been progressed to detailed analysis.

PROGRESSED TO DETAILED ANALYSIS

Based on the optioneering the table below summarises the benefits of each option:

	Do Nothing	Minimum Requirements	Responsible Operator	Progressive Network Enabler
Full resilience of comms network	✗	✗	✓	✓
Fully Support system monitoring	✗	✗	✓	✓
Fully Support digitisation of network	✗	✗	✓	✓
Fully dual diverse fibre network	✗	✗	✓	✓
Support interdependent projects	✗	✗	✓	✓
Secure data network connections	✗	✗	✗	✓

Table 1 - Optioneering Summary

5 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.

5.1 Risk & Benefit Analysis

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

In order to demonstrate the benefits of delivering this project, we have carried out a Risk and Benefit Analysis. 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.

This exercise was carried out for the Communications Upgrades proposals. As can be seen in Table 2, the Unmitigated Risk Rating is "Severe". Once all the mitigations are taken into account, the Mitigated Risk Rating falls to "High" for Responsible Operator and is further reduced to "Medium" for the Progressive Network Operator option. The full Risk & Benefit Analysis is contained within Appendix C.

				Responsible Operator	Progressive Network Enabler
Risk ID	Risk Title	Risk	Unmitigated Overall Risk Rating	Mitigated Overall Risk Rating	Mitigated Overall Risk Rating
1	Integrated Condition & Performance Monitoring	Non-Delivery of Integrated Condition & Performance Monitoring programme, which is dependent on resilient communications	Severe	Medium	Medium
2	Protection	Non-Delivery of Protection Modernisation programme, which is dependent on resilient communications	Severe	Medium	Medium
3	SCADA	Non-Delivery of SCADA Upgrade programme, which is dependent on resilient communications	Severe	Medium	Medium
4	STCP 27-01	Lack of required communications will prevent compliance with STCP 27-01	Severe	High	Medium
5	Personnel Comms	VOTN technology would not be available	Severe	High	Medium
		OVERALL	**Severe**	**High**	**Medium**

Table 2 - Risk and Benefit Analysis Results

5.2 Stakeholder Engagement

On 5 March 2019, SHE Transmission hosted a stakeholder workshop, aimed at gathering feedback from its stakeholders on its approach to network resilience and reliability for the RIIO-T2 plan. A total of 46 stakeholders attended the workshop, representing 31 organisations.

During the discussions, it was generally agreed that SHE Transmission should take the 'Progressive Network Enabler' approach to communications. Stakeholders felt that it was important for SHE Transmission to use the latest technologies. There was a feeling that it was right to invest now in order to have a better performing network in future – and that there would be a financial benefit to doing so, even if it was hard to quantify. Stakeholders also noted that the delivery of other programmes of work was dependant on this, and that should be considered.

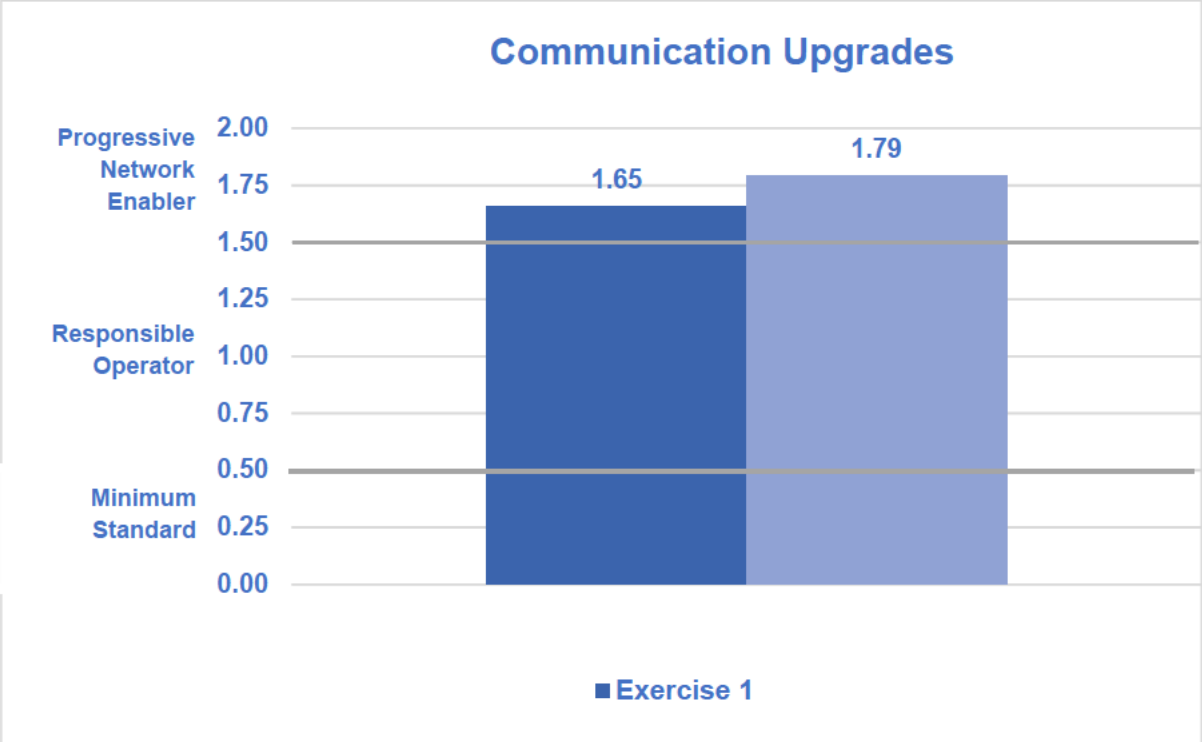


Figure 2 - Stakeholder Feedback

Stakeholders felt it was important for us to use the latest technology and supported the view that investment now would offer long term financial benefit, in addition to enabling improvements in other areas of the business. They did, however, urge us to prioritise key substations first and to trial new technologies on a small scale before undertaking a large-scale roll-out.

5.3 Costs – Responsible Operator

As described above, this option will perform the OHL fibre wire upgrades only. This is forecast to cost £17.11m.

5.4 Costs – Progressive Network Enabler

The scope of this option covers the Installation of the "Responsible Operator" approach as well as local site network connection and cyber security enhancements. This is forecast to cost £31.10m, as outlined in table 3.

Further information on the works denoted above are contained in Appendix A.

	Responsible Operator	Progressive Network Enabler
Transport	[redacted]	[redacted]
Multiplexer	[redacted]	[redacted]
Data		[redacted]
Cyber Security		[redacted]
Remote Management		[redacted]
On Costs	[redacted]	[redacted]
Risk & Contingency	[redacted]	[redacted]
Total	£17.11M	£31.10M

Table 3 - Options cost

These costs have been developed with respect to previous installation experience as well as costs associated with the appropriate contractors.

5.5 Proposed Solution

We have examined each of the options in terms of three comparative factors:

- Cost
- Risk Reduction
- Stakeholder Requirements

and have determined through this analysis which is the preferred option.

The "Progressive Network Enabler" option is to be preferred, as it delivers improved performance and greater risk reduction to the "Responsible Operator" option and aligns with Stakeholder Requirements, as well as enabling full compliance with STCP 27-01.

6 Conclusion

The significant changes to the transmission network and the increasing levels of data capture and transfer requirements, along with the wider deployment of IP based equipment, has placed higher demand on our communications network and required a medium which is high speed, high bandwidth, secure and resilient to ensure the integrity of protection, control and monitoring of the transmission system. These factors are driving the need to provide secure, resilient, dual and diverse fibre optic connections to all substations.

We have determined a need to increase the quantity of data that can be received from our assets and way that data can be used within internal systems to more accurately see asset operation and condition. This data can then be used for failure prediction and better real time monitoring for the transmission control room and the System Operator.

An optioneering assessment took place which investigated 4 options. Two options were taken forward for detailed analysis.

During the detailed analysis review, specific substations and circuits were highlighted for improvements. The project scope also outlined upgrades required to perform local network enhancements at each substation.

Given the preceding information, a decision has been made to deploy the "Progressive Network Enabler" option, which will improve our communication capabilities to meet increasing communication requirements as we digitise our network. This will require the installation of new fibre optic communication routes. as well as providing the substation network connection enhancements and allowing compliance with STCP 27-01.

SHE Transmission has outlined the following deliverables for this approach;

- Upgrade to a fibre optic communications medium on the replacement / refurbishment of existing protection and control systems.
- Completing a full, dual, diverse fibre network to all Transmission substations with interconnections to adjoining Transmission Operators.
- Install secure data network connections into all Transmission substations complete with cyber security devices.

The cost forecast for the project is £31.10m.

This scheme is not flagged as eligible for early or late competition due to it being under Ofgem's £50m and £100m thresholds respectively.

7 Price Control Deliverables and Ring Fencing

As set out in our Regulatory Framework paper (section 1.12 and Appendix 3) we support a key principle from Citizens Advice – one that guarantees delivery of outcomes equivalent to the funding received - to ensure that RIIO-T2 really deliver for consumers. At the project level this means that if we don't deliver the output, or a materially equivalent outputs, we commit to returning the ex-ante allowance for the output not delivered.

This means that if the funding for Transmission Communications Upgrade should be ring-fenced and if it does not go ahead, we will return the allowances of £31.10m in full (minus any justified preconstruction expenditure).

It also means that we commit to delivering the output specified above for the costs of £31.10m. If we do not deliver the output, or a materially equivalent output, we commit to returning a proportion of the ex-ante allowance. The detailed methodology should be decided at when developing the Close Out methodologies but should apply the same principles of uncertainty mechanisms - that any under delivery should be material.

8 Outputs included in RIIO-T1 Plans

There are no outputs associated with this scheme included in our RIIO-T1 plans.

9 References

- STCP 27-01 System Performance Monitoring
- SCADA Upgrades (T2BP-EJP-0002)
- Protection Upgrades (T2BP-EJP-0004)
- Smart Monitoring (T2BP-EJP-0012
- Control Centre (T2BP-EJP-0013)

Appendix A

Transport

This aspect constitutes the installation of fibre wire in the following circuits and substations

Site Name	Circuit	Cost (£)
ARBROATH GRID	N/A	[redacted]
BRIDGE OF DUN GRID	N/A	[redacted]
FRASERBURGH GRID	SF1/SF2	[redacted]
GLENAGNES GRID	N/A	[redacted]
KILLIN GRID	ELW	[redacted]
LUNANHEAD GRID	TLE/TLW	[redacted]
MACDUFF GRID	KMN/KMS	[redacted]
MILTON OF CRAIGIE GRID	TM1/TM2	[redacted]
PERSLEY GRID	N/A	[redacted]
ROTHIENORMAN	N/A	[redacted]
ST FILLANS GRID	N/A	[redacted]
STRICHEN GRID	SF2	[redacted]
TARLAND GRID	CL1/CL2	[redacted]
WOODHILL GRID	N/A	[redacted]

Table 2 - Transport requirements

Multiplexers

This aspect looks at the installation of Multiplexers with line and service cards at the following sites:

Site Name	Mux Cost (£)
ABERNETHY GRID	[redacted]
AIGAS GRID	
ALNESS GRID	
AN SUIDHE GRID	
ARBROATH GRID	
ARDKINGLAS GRID	
ARDMORE GRID	
BEAULY GRID	
BOAT OF GARTEN GRID	
BRACO GRID	
BRACO WEST GRID	
BRECHIN GRID	
BRIDGE OF DUN GRID	
BROADFORD GRID	
BRORA GRID	
BURGHMUIR GRID	
CLUNIE DAM GRID	
CARRADALE GRID	
CASSLEY GRID	
CEANNACROC GRID	
CHARLESTON GRID	
CLACHAN GRID	
CLAYHILLS GRID	
CORRIEMOILLIE GRID	
COUPAR ANGUS GRID	
CRAIGIEBUCKLER GRID	
CRARAE GRID	
CROSSAIG GRID	
DEANIE GRID	
DUNBEATH GRID	
DUNMAGLASS GRID	
DUNOON GRID	
DUNVEGAN GRID	
EDINBANE	
ELGIN GRID	

Site Name	Mux Cost (£)
FARR GRID	[redacted]
FASNAKYLE GRID	
FERNOCH GRID	
FIDDES GRID	
FINLARIG GRID	
FORT AUGUSTUS GRID	
FRASERBURGH GRID	
GLENFARCLAS GRID	
GLENMORISTON GRID	
GORDONBUSH WIND GRID	
GRIFFIN GRID	
GRUDIE BRIDGE GRID	
HARRIS GRID	
INVERARAY GRID	
INVERARNAN GRID	
INVERGARRY GRID	
INVERNESS GRID	
KEITH GRID	
KILLIN GRID	
KILMORACK GRID	
KINLOCHLEVEN GRID	
LAIRG GRID	
LOCHAY GRID	
LUICHART GRID	
LUNANHEAD GRID	
LYNDHURST GRID	
MACDUFF GRID	
MILLENNIUM WIND	
MILTON OF CRAIGIE GRID	
MOSSFORD GRID	
NAIRN GRID	
NANT GRID	
ORRIN GRID	
PERSLEY GRID	
PETERHEAD GRANGE GRID	

Site Name	Mux Cost (£)
PETERHEAD PS GRID	[redacted]
PETERHEAD SHELL GRID	
PORT ANN GRID	
RANNOCH GRID	
REDMOSS GRID	
SHIN GRID	
SLOY GRID SWITCHING STN	
ST FERGUS MOBIL GRID	
ST FERGUS SWITCHING STN	

Site Name	Mux Cost (£)
ST FERGUS VSD GRID	[redacted]
ST FILLANS GRID	
STORNOWAY GRID	
STRICHEN GRID	
TARLAND GRID	
TAYNUILT GRID	
TUMMEL BRIDGE GRID	
WILLOWDALE GRID	
WOODHILL GRID	

Table 3 – MUX requirements

Data

This lays out the requirements for the installation of onsite network stacks, corporate network stacks, wiring and site racks at the following substations.

Site Name	Data Cost (£)
ABERNETHY GRID	[redacted]
AIGAS GRID	
ALNESS GRID	
AN SUIDHE GRID	
ARBROATH GRID	
ARDKINGLAS GRID	
ARDMORE GRID	
BEAULY GRID	
BHLARAIDH	
BOAT OF GARTEN GRID	
BRACO GRID	
BRACO WEST GRID	
BRECHIN GRID	
BRIDGE OF DUN GRID	
BROADFORD GRID	
BRORA GRID	
BURGHMUIR GRID	
CLUNIE DAM GRID	
CARRADALE GRID	
CASSLEY GRID	
CEANNACROC GRID	

Site Name	Data Cost (£)
CHARLESTON GRID	[redacted]
CLACHAN GRID	
CLAYHILLS GRID	
CORRIEMOILLIE GRID	
COUPAR ANGUS GRID	
CRAIGIEBUCKLER GRID	
CRARAE GRID	
CROSSAIG GRID	
DEANIE GRID	
DUNBEATH GRID	
DUNMAGLASS GRID	
DUNOON GRID	
DUNVEGAN GRID	
EDINBANE	
ELGIN GRID	
FARR GRID	
FASNAKYLE GRID	
FERNOCH GRID	
FIDDES GRID	
FINLARIG GRID	
FORT AUGUSTUS GRID	

Site Name	Data Cost (£)
FRASERBURGH GRID	[redacted]
GLENFARCLAS GRID	
GLENMORISTON GRID	
GORDONBUSH WIND	
GRIFFIN GRID	
GRUDIE BRIDGE GRID	
HARRIS GRID	
INVERARAY GRID	
INVERARNAN GRID	
INVERGARRY GRID	
INVERNESS GRID	
KEITH GRID	
KILLIN GRID	
KILMORACK GRID	
KINLOCHLEVEN GRID	
LAIRG GRID	
LOCHAY GRID	
LUICHART GRID	
LUNANHEAD GRID	
LYNDHURST GRID	
MACDUFF GRID	
MILLENNIUM WIND GRID	
MILTON OF CRAIGIE GRID	

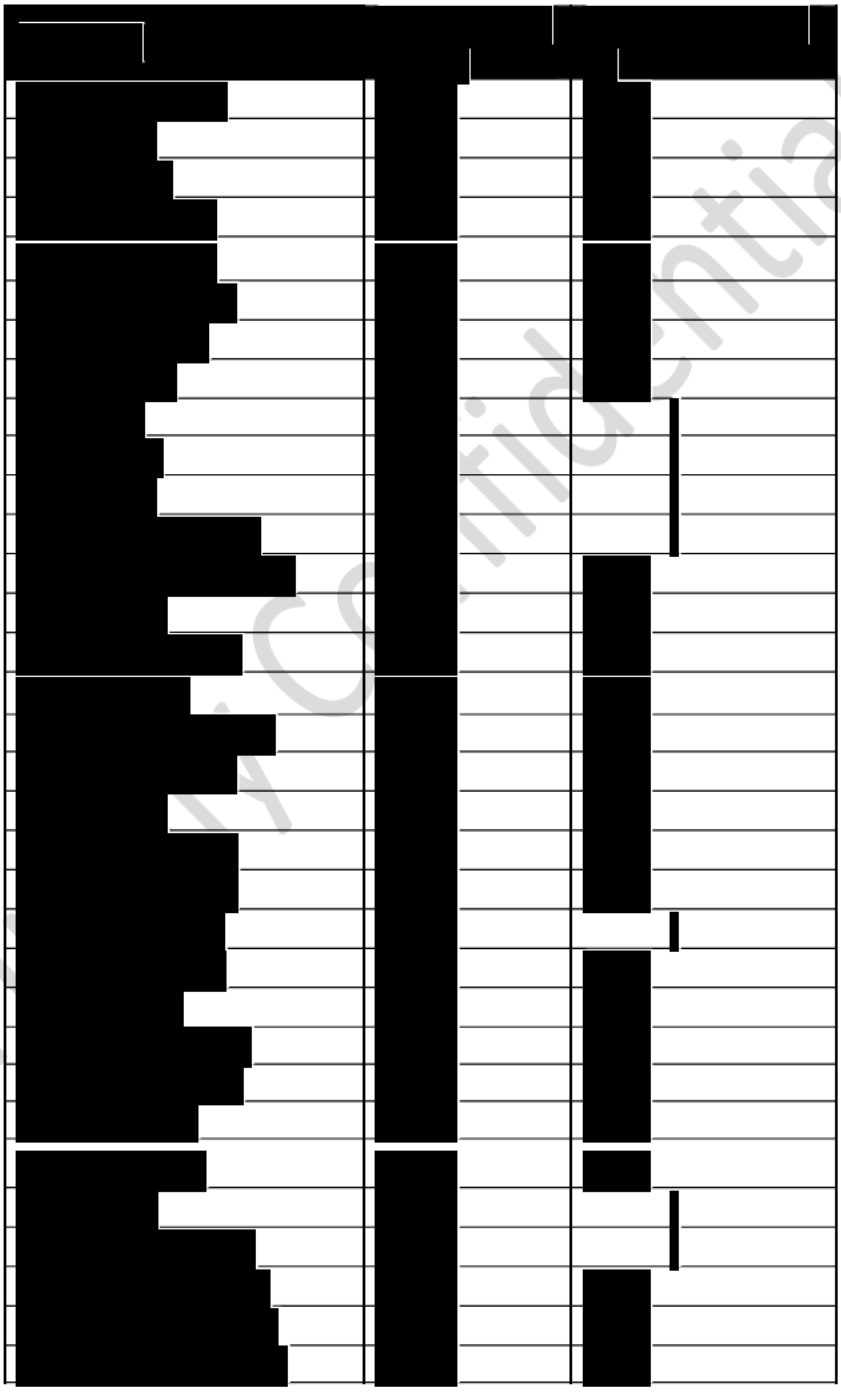
Site Name	Data Cost (£)
MOSSFORD GRID	[redacted]
NAIRN GRID	
NANT GRID	
ORRIN GRID	
PERSLEY GRID	
PETERHEAD GRANGE GRID	
PETERHEAD PS GRID	
PETERHEAD SHELL GRID	
PORT ANN GRID	
RANNOCH GRID	
REDMOSS GRID	
SHIN GRID	
SLOY GRID SWITCHING STN	
ST FERGUS MOBIL GRID	
ST FERGUS SWITCHING STN	
ST FERGUS VSD GRID	
ST FILLANS GRID	
STORNOWAY GRID	
STRICHEN GRID	
TARLAND GRID	
TAYNUILT GRID	
TUMMEL BRIDGE GRID	
WILLOWDALE GRID	
WOODHILL GRID	

Table 4 – Data Requirements

Appendix B

Cyber Security and Remote Management

[redacted]



Site Name	Cyber Security Cost (£)	Management Cost (£)
CRARAE GRID	[redacted]	[redacted]
CROSSAIG GRID		
CULLIGRAN GRID		
DALLAS GRID		
DEANIE GRID		
DORENELL GRID		
DOUNREAY SUPERGRID		
DUDHOPE GRID		
DUNBEATH GRID		
DUNMAGLASS GRID		
DUNOON GRID		
DUNVEGAN GRID		
DYCE GRID		
EDINBANE		
ELGIN GRID		
ERROCHTY GRID		
FARIGAIG GRID		
FARR GRID		
FASNAKYLE GRID		
FERNOCH GRID		
FETTERESSO GRID		
FIDDES GRID		
FINLARIG GRID		
FORT AUGUSTUS GRID		
FORT WILLIAM GRID		
FOYERS GRID		
FRASERBURGH GRID		
FYRISH		
GLENAGNES GRID		
GLENDOE		
GLENFARCLAS GRID		
GLENMORISTON GRID		
GORDONBUSH WIND GRID		
GRIFFIN GRID		
GRUDIE BRIDGE GRID		
HARRIS GRID		
INVERARAY GRID		
INVERARNAN GRID		
INVERGARRY GRID		
INVERNESS GRID		

Site Name	Cyber Security Cost (£)	Management Cost (£)
KEITH GRID	[redacted]	[redacted]
KILLIN GRID		
KILMORACK GRID		
KINLOCHLEVEN GRID		
KINTORE GRID		
KNOCKNAGAEL		
LAIRG GRID		
LOCHAY GRID		
LOCH BUIDHE		
LUICHART GRID		
LUNANHEAD GRID		
LYNDHURST GRID		
MACDUFF GRID		
MELGARVE		
MILLENNIUM WIND GRID		
MILTON OF CRAIGIE GRID		
MOSSFORD GRID		
MYBSTER GRID		
NAIRN GRID		
NANT GRID		
NEW DEER		
ORRIN GRID		
PERSLEY GRID		
PETERHEAD GRANGE GRID		
PETERHEAD GRID		
PETERHEAD PS GRID		
PETERHEAD SHELL GRID		
PORT ANN GRID		
QUOICH GRID		
QUOICH TEE GRID		
RANNOCH GRID		
REDMOSS GRID		
ROTHIENORMAN		
SHIN GRID		
SLOY GRID SWITCHING STN		
SPITTAL		
ST FERGUS GAS GRID		
ST FERGUS MOBIL GRID		
ST FERGUS SWITCHING STN		
ST FERGUS VSD GRID		

Site Name	Cyber Security Cost (£)	Management Cost (£)
ST FILLANS GRID	[redacted]	[redacted]
STONEYWOOD		
STRATHY WIND		
STRONELAIRG		
STORNOWAY GRID		[redacted]
STRATHBRORA WINDFARM		
STRICHEN GRID		[redacted]
TARLAND GRID		
TAYNUILT GRID		
TEALING GRID		
THURSO GRID		
TOMATIN		
TUMMEL 275/132KV		
TUMMEL BRIDGE GRID		[redacted]
WILLOWDALE GRID		
WOODHILL GRID		

Table 5 – Data requirements

Appendix C

Scottish & Southern Electricity Networks TRANSMISSION

Project Risk & Benefit Matrix - Responsible Operator

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Impact	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Impact	Mitigated Overall Risk Rating	Benefits
1	Integrated Condition & Performance Monitoring	A separate project, dependent on resilient communications, is being proposed in RIIO-T2 for Integrated Condition & Performance Monitoring	Almost Certain	Major	Severe	Develop resilient communications network	Almost Never	Major	Medium	Allows real-time monitoring for asset performance and condition
2	Protection Modernisation	Non-Delivery of Protection Modernisation programme, which is dependent on resilient communications	Almost Certain	Severe	Severe	Develop resilient communications network	Almost Never	Severe	Medium	Enables delivery of real-time and post-event monitoring
3	SCADA Upgrades	Non-Delivery of SCADA Upgrade programme, which is dependent on resilient communications	Almost Certain	Severe	Severe	Develop resilient communications network	Almost Never	Severe	Medium	Enables development of substations to become enhanced with the latest
4	STCP 27-01	Lack of required communications will prevent compliance with STCP 27-01	Almost Certain	Major	Severe	Develop resilient communications network	Unlikely	Major	High	Compliance with STCP 27-01
5	Personnel Comms	VOTN technology would not be available	Almost Certain	Major	Severe	Develop resilient communications network	Unlikely	Major	High	Allows for the delivery of the VoTN network

Figure 3 - Risk & Benefit Matrix – Responsible Operator

Scottish & Southern Electricity Networks TRANSMISSION

Project Risk & Benefit Matrix - Progressive Network Enabler

Risk ID	Risk Title	Risk	Unmitigated Risk Likelihood	Unmitigated Risk Impact	Unmitigated Overall Risk Rating	Mitigation Action	Mitigated Risk Likelihood	Mitigated Risk Impact	Mitigated Overall Risk Rating	Benefits
1	Integrated Condition & Performance Monitoring	A separate project, dependent on resilient communications, is being proposed in RIIO-T2 for Integrated Condition & Performance Monitoring	Almost Certain	Major	Severe	Develop resilient communications network, including the installation of secure data networks into substations	Almost Never	Major	Medium	Allows real-time monitoring for asset performance and condition. Substations can facilitate their own network. Improved cyber security
2	Protection Modernisation	Non-Delivery of Protection Modernisation programme, which is dependent on resilient communications	Almost Certain	Severe	Severe	Develop resilient communications network, including the installation of secure data networks into substations	Almost Never	Severe	Medium	Enables delivery of real-time and post event monitoring
3	SCADA Upgrades	Non-Delivery of SCADA Upgrade programme, which is dependent on resilient communications	Almost Certain	Severe	Severe	Develop resilient communications network, including the installation of secure data networks into substations	Almost Never	Severe	Medium	Enables development of substations to become enhanced with the latest cyber security and operate in line with IEC 61850 & accelerate the drive towards protection over IP and the wider digital substation strategy
4	STCP 27-01	Lack of required communications will prevent compliance with STCP 27-01	Almost Certain	Major	Severe	Develop resilient communications network, including the installation of secure data networks into substations	Almost Never	Major	Medium	Compliance with STCP 27-01
5	Personnel Comms	VOTN technology would not be available	Almost Certain	Major	Severe	Develop resilient communications network, including the installation of secure data networks into substations	Almost Never	Major	Medium	Allows for the delivery of the VoTN network

Figure 4 - Risk & Benefit Matrix – Progressive Network Enabler

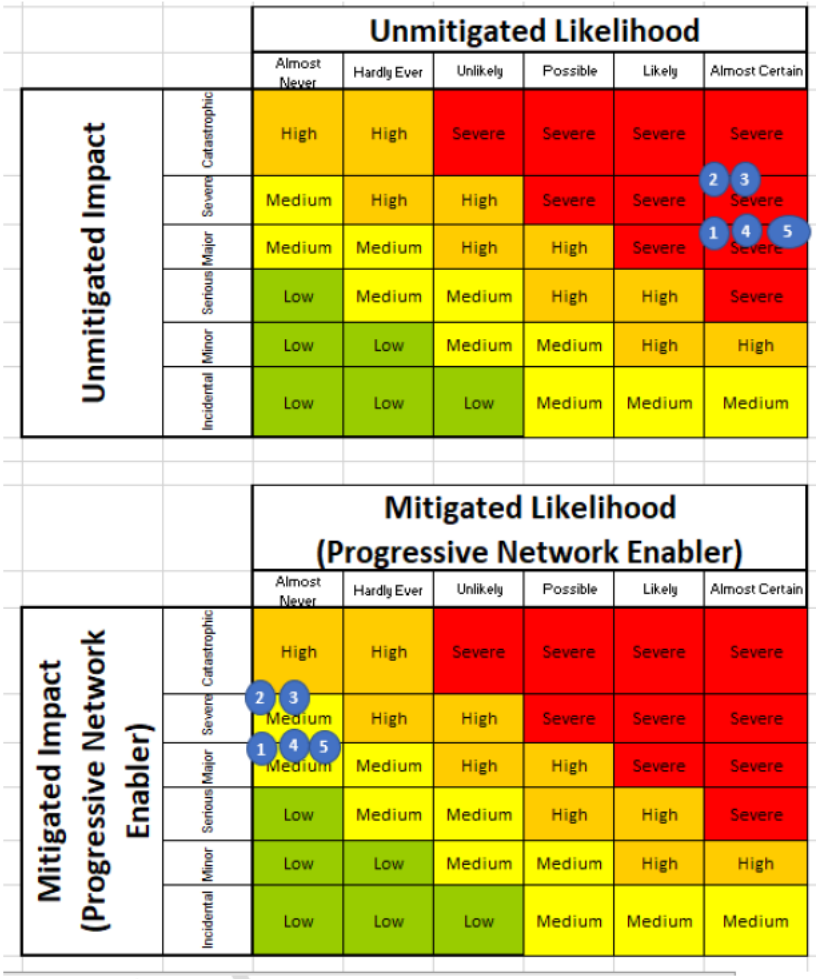


Figure 5 - Risk Heat Maps for Preferred Option