Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan T2BP-EJP-0046

St Fergus Mobil 132kV Substation Works

Engineering Justification Paper

1 Executive Summary

Our paper A Risk Based Approach to Asset Management[1] sets out our approach to network risk and how we subsequently identify assets that require intervention to limit the rise of risk over the RIIO-T2 period.

This paper identifies the need for intervention on the 132kV switchgear at St Fergus Mobil Substation. The asset condition at St Fergus Mobil is the primary driver, however, the chosen option has been selected as it addresses the network resilience limitations, therefore network resilience should also be noted as a key driver.

Following a process of optioneering and detailed analysis, as set out in this paper, the proposed scope of works is:

- Offline replacement of new indoor substation, including replacement of existing 132kV fluid filled cables; and,
- Additional two 132kV circuit breakers installed at St Fergus Switching Station.

This scheme will cost £12.7m and will delivers the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of -R£110m; see Section 5 for details;
- A reduction of total network risk calculated as R£32m;
- Improved operational flexibility and resilience in line with our goal to aim for 100% transmission network reliability for homes and businesses;
- A reduction in the volume of SF_6 on the network from the use of innovative non SF_6 equipment contributing to our goal of a one third reduction in greenhouse gas emissions.

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

[1] A Risk Based Approach to Asset Management

Name of Scheme/Programme	St Fergus Mobil 132kV Substation Works
Primary Investment Driver	Asset Health (Non-Load)
Scheme reference/ mechanism or category	SHNLT2031
Output references/type	NLRT2SH2031
Cost	£12.7m
Delivery Year	Within the RIIO-T2 period
Reporting Table	C0.7 Non-Load Master Data
Outputs included in RIIO-T1 Business Plan	No

2 Introduction

This Engineering Justification Paper sets out our plans to undertake condition-related work during the RIIO-T2 period (April 2021 to March 2026). The planned work is at St Fergus Mobil substation which is shown overleaf in Figure 1.

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

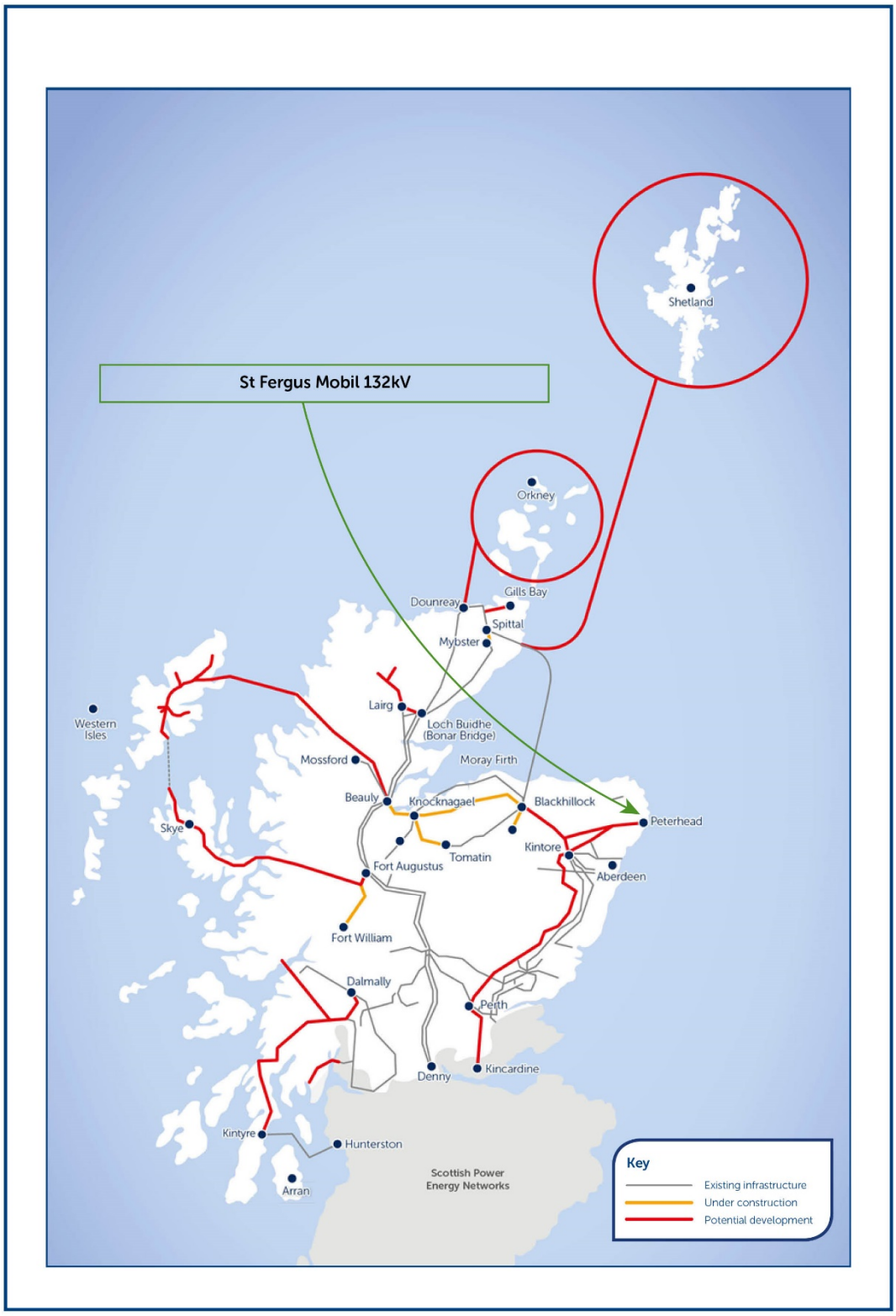
This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

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 mechanism.

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.


St Fergus Mobil 132kV
Shetland
Orkney
Dounreay
Gills Bay
Spittal
Mybster
Lairg
Loch Buidhe (Bonar Bridge)
Western Isles
Mossford
Moray Firth
Beauly
Knocknagael
Blackhillock
Peterhead
Skye
Tomatin
Kintore
Fort Augustus
Aberdeen
Fort William
Dalmally
Perth
Denny
Kincardine
Kintyre
Hunterston
Arran
Scottish Power Energy Networks
Key
Existing infrastructure
Under construction
Potential development

3 Need

3.1 Background

St. Fergus Mobil Substation, which is situated approximately 50km north of Aberdeen, [redacted] SHE Transmission owns the 132kV switchgear in the substation, with the connected customer owning the rest. This site is connected to the transmission network by a double circuit to St. Fergus Switching Station. [redacted] Appendix A and B show illustrations of the transmission network and of St. Fergus Mobil Substation respectively.

3.2 Asset Need

Ongoing site inspections provide detailed condition assessment of the plant along with the data gathered from testing and analysis. The resulting asset condition report[2] provides, in detail, the condition of existing assets and recommendations for intervention in the RIIO-T2 period. A summary of the highlighted condition issues, all relating to the 132kV switchgear, are:

- The current circuit breakers both have a condition score of four, the highest value on the iSIM condition rating definitions, and indicates serious deterioration;
- Both circuit breakers (CBs) have had significant issues with SF_6 leakage in the RIIO T1 period, one of which required significant intervention;
- All the existing 132kV switchgear exhibit corrosion,
- The switchgear is housed outdoors and due to the proximity to the coast (1.2km from the North Sea) is deteriorating at an accelerated rate due to the salt laden atmosphere;
- The SF_6 pipework on the two CBs is of concern and component replacement or maintenance is not possible; and,
- The two circuit breaker marshalling kiosks are showing significant corrosion.

In addition to the condition-related issues outlined above there are multiple operational limitations on the existing arrangement which increases network risk. [redacted]

[2] St Fergus Mobil Asset Condition Report T2BP-ACR-0030

- The disconnectors and interlocking system at St Fergus Mobil need to be manually operated limiting of operational speed, flexibility, and safety;

3.3 Growth Need

A summary of the latest demand and generation capacity connected via these GTs to the wider network is summarised in the tables below:

Table 1: St Fergus Mobil Demand & Generation Summary

Demand		Generation		
Winter Peak (MW)	Summer Min (MW)	Connected (MW)	Contracted (MW)	Total (MW)
9.06	0.24	N/A	N/A	N/A

Demand is not projected to significantly rise in the medium term, thus there is no growth need to be considered for the site.

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.

The recommendation from the need, outlined in section 3, means that intervention is required in the RIIO-T2 price control period so the "do nothing" option is not valid.

The need section identified that all 132kV switchgear require intervention. A summary of the options is presented in the table below:

Table 2: Options Summary

Option	Option Detail	Cost (£m)	Taken forward to Detailed Analysis?
1	Refurbish existing switchgear in situ	-	No
2	Offline build of new indoor substation, including replacement of existing 132kV fluid filled cables	-	No
3	As option 2, with the installation of 2x 132kV Circuit Breakers at St Fergus switching station on SM1/SM2	12.7	Yes
4	Replace switchgear in situ	-	No

With regards to interfacing projects that need to be considered when reviewing these options, any outages taken for these proposed works must be coordinated with the outages under the Peterhead to Inverugie overhead line works in order to secure supplies on the 132kV network.

Option 1: Refurbish existing switchgear in-situ

This option considers the refurbishment of the 132kV switchgear at the existing substation. This option has the following limitations:

- The existing site is not currently specification compliant as equipment within such proximity to the coast should be indoors,
- This option would not solve the current corrosion caused by plant exposure to the marine environment. Therefore, any refurbishment carried out would be under the same environmental pressures caused by the salt air corrosion,

Based on these factors, this option is deemed not feasible and will not be progressed.

NOT PROGRESSED TO DETAILED ANALYSIS

Option 2: Offline rebuild including 132kV cable replacement

This option considers an offline rebuild of the St Fergus Mobil site, including 132kV cable replacement. This solution allows all the condition-related needs to be addressed, as well as specification alignment in the form of housing this plant indoors, thus putting in place a solution that will preserve the installed assets.

However, the distinctive factor between this option and Option 3, is that this solution fails to resolve the lack of operational flexibility at St Fergus switching station. It is for this reason that this option has not been progressed to detailed analysis.

NOT PROGRESSED TO DETAILED ANALYSIS

Option 3: Offline rebuild including 132kV cable replacement and installation of two 132kV CBs at St Fergus Switching Station

This option considers an offline rebuild of the St Fergus Mobil site, including 132kV cable replacement, with the addition of the installation of two 132kV circuit breakers at St Fergus Switching Station. This solution allows all the condition-related needs to be addressed, as well as specification alignment in the form of housing this plant indoors, thus putting in place a solution that will preserve the installed assets.

This option includes the addition of two circuit breakers at St Fergus Switching Station, on SM1 and SM2 circuits, which significantly reduce the risk of a failure or outage within the St Fergus network.

This solution, along with solving all the operational and environmental limitations also resolves the lack of operational flexibility at St Fergus switching station by mitigating the risk of placing [redacted] part of the network onto single circuit during faults. It is for these reasons that this option has been put forward for more detailed analysis.

PROGRESS TO DETAILED ANALYSIS

Option 4: Replace switchgear in-situ

This option considers the in-situ rebuild of the St Fergus Mobil site. This option suffers from the following limitations:

- The existing site is not specification compliant as equipment within such proximity to the coast should be indoors;
- This solution fails to resolve the lack of operational flexibility at St Fergus switching station;

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

NOT PROGRESSED TO DETAILED ANALYSIS

5 Detailed Analysis

5.1 Cost Benefit Analysis

Only Option 3 was identified as satisfying the criteria set out in the needs section, thus no CBA was carried out.

5.2 Proposed Solution

The scope of the selected solution is to build an offline 132kV building to house the new 132kV switchgear, along with the addition of two new circuit breakers at St Fergus Switching Station. A copy of the Single Line Diagram (SLD) is shown in Appendix C. The project will be energised within the RIIO-T2 period. The table below details the outputs.

Table 3: Outputs from preferred option

Plant	Size of new plant	Replacement for
Offline build of new indoor substation, plus the installation of 2 new 132kV circuit breakers at St Fergus Switching Station.	4x 132kV circuit breakers 4x 132kV disconnectors 6x 132kV earth switches 2km 132kV XLPE cable	2 x 132kV circuit breakers 2 x disconnectors 2 x earth switches 2km x 132kV oil filled cable

5.3 Competition

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

5.4 Risk Benefit

A Risk Benefit Analysis has been carried out in order to compare "no intervention" against the selected "with intervention" option. Please note that while monetised risk is denoted as a financial figure, it is important to note that it is not "real" money and does not correspond to the cost that SHE Transmission would incur if an asset was to fail and these values are thus identified with R£ prefix (for more details please refer to A Risk Based Approach to Asset Management[1]).

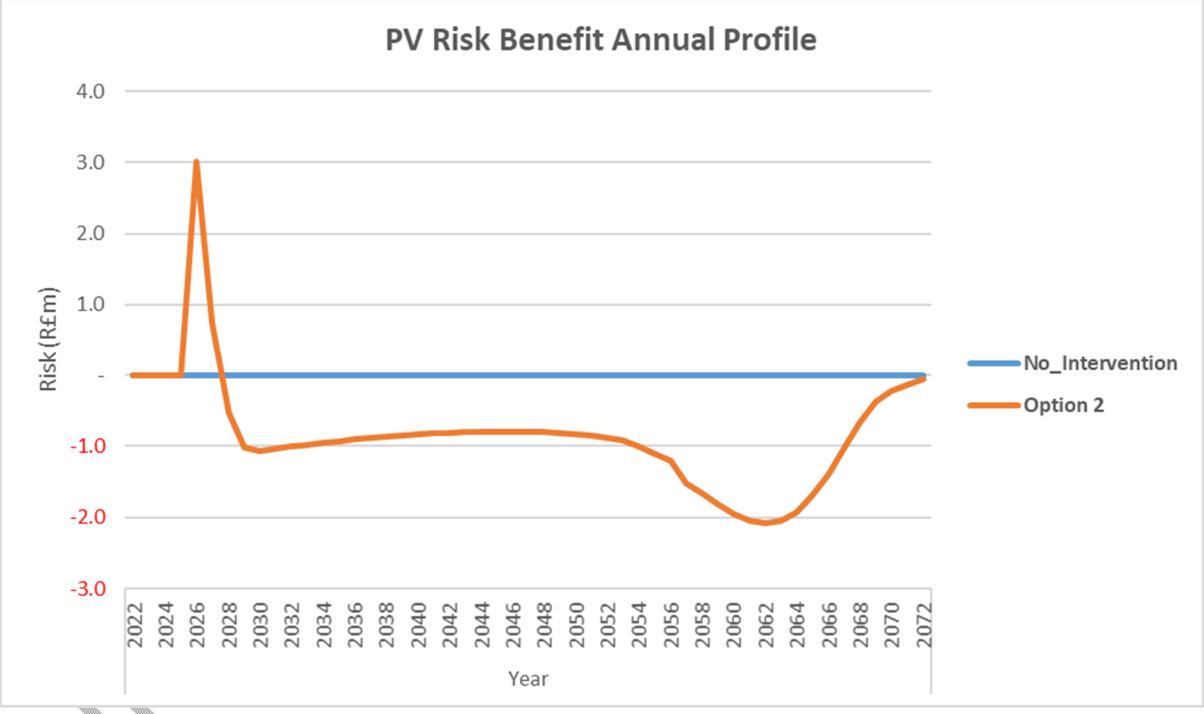
The long-term monetised risk benefit which would be realised through the completion of this project is R£-110m. The long-term benefit is derived by consideration of the risk of the asset experiencing a catastrophic failure weighted by the probability that the asset will survive for the Options and "no intervention" scenarios. The long-term benefit is an aggregation of the risk of all assets being

considered within the option. The risk of each Option is then compared with the "no intervention" scenario. The "no intervention" scenario assumes that when the asset experiences a catastrophic failure the asset is replaced.

The CBRM function which projects the 50-year view cannot currently model future interventions beyond T2. Therefore, some projects show a negative Long-Term Risk Benefit, particularly where additional assets are added, existing assets are refurbished or where the life of an asset is substantially less than the 50 year view.

The reason that the Long-Term Risk Benefit of this project is a negative is due to additional assets that did not exist before. Although this provides better system security and selectability, the LTRB template does not take this into account, and projects the risk of all assets at the site in 50 years' time.

Figure 2: Long Term Benefit of Proposed Intervention – Replace 2 CBs at St Fergus, also to add 2 CBs and replace cable.



In addition to assessing the long-term risk benefit, a monetised risk benefit has also been determined. The monetised risk benefit which would be realised through the completion of this project is R£32m.

5.5 Project Sensitivity

As outlined in our core RIIO-T2 business plan document, "A Network for Net Zero", we believe we have a critical role to play in delivering Net Zero ambitions in both the UK and Scotland. Therefore, our plan has been carefully designed with the flexibility to deliver pathways to Net Zero. Our policy

paper "A Risk-Based Approach to Asset Management" outlines our approach to monitoring and assessing the condition of our assets to maintain the reliable and resilient network that is expected by our stakeholders. Where asset condition deteriorates, we undertake a programme of cost-effective, risk-based interventions to maintain the longevity and performance of the transmission network. Each of our non-load related projects for T2 is underpinned by Asset Condition Reports which clearly outline that the works are necessary and driven by reliability.

Table 4: Sensitivity Analysis table

Sensitivity	Test and impact observed – switching inputs
Asset Performance / deterioration rates	Switching deterioration assumption: Improved - need driven by asset condition report and will not improve in intervening period. Deteriorated – Need remains, project would be considered for advancement within available outages.
Ongoing efficiency assumptions	Switching efficiency assumption: Increased or decreased. Test would have no impact on (feasible) option selection, both the options move in parallel and have no impact on ordering within CBA.
Demand variations	No significant demand forecast
Energy scenarios	No significant generation forecast
Asset utilisation	Our policy paper "A Risk-Based Approach to Asset Management" outlines our approach to monitoring and assessing the condition of our assets to maintain the reliable and resilient network that is expected by our stakeholders. Where asset condition deteriorates, we undertake a programme of cost-effective, risk-based interventions to maintain the longevity and performance of the transmission network. Each of our non-load related projects for T2 is underpinned by Asset Condition Reports which clearly outline that the works are necessary and driven for reliability.
Timing / delivery	We have considered timing of investments as part of our analysis.
Consenting / stakeholders	Where applicable we have considered consenting and stakeholder engagement and the impact which this has had on the selection of the preferred solution.

Public policy / Government legislation	We have considered the impact of public policy, government legislation and regulations as part of the need, optioneering and detailed analysis and the impacts this has on the selection of the preferred solution.

5.6 Innovation & Sustainability

The new circuit breakers at St Fergus Mobil and St Fergus Switching Station will employ a non-SF_6 filled solution in support of our Sustainability and Environmental policies.

5.7 Carbon Modelling

We are committed to managing resources over the whole asset lifecycle – i.e. including the manufacturing of assets, construction, operations and decommissioning activities – to reduce our greenhouse gas emissions in line with climate science and become a climate resilient business. It is our aspiration that the carbon lifecycle cost of investment options plays a key role within our project development and is considered in the selection of a preferred solution. We have therefore developed an internal carbon pricing model that estimates a carbon cost deriving values for:

1. Embodied carbon, which relates to the carbon emissions associated with the manufacturing and production of the materials use in production of the lead assets (transformer, reactors, underground cables and Overhead lines. Overhead line is made up of tower/wood pole/composite pole, conductor and fittings) procured and installed as part of the project.

2. The carbon emissions associated with the main stages of the project lifecycle (construction, operations and decommissioning).

It is our vision to embed carbon considerations within our strategic optioneering and project development processes, which will require us to determine a way of flagging high carbon options within our CBA outputs. We will continue to develop our thinking in this space, which will involve our model being validated by a third party, so the results included in this EJP are indicative and subject to change.

In terms of the results of analysis for this project, which are captured in the carbon footprint results table,

Table 5: Carbon Calculation Summary

	Project Information	Baseline
Project info	Project Name/number	0
	Construction Start Year	2026
	Construction End Year	2028
Cost estimate £GBP	Embodied carbon	£ 123,732
	Construction	£ 245,123
	Operations	£ 73,879
	Decommissioning	£ 112,224
	Total Project Carbon Cost Estimate	**£ 554,958**
Carbon footprint tCO2e	Embodied carbon	1,652
	Construction	3,224
	Operations	323
	Decommissioning	322
	Total Project Carbon (tCO2e)	**5,522**
Project Carbon Footprint by Emission Category	Total Scope 1 (tCO2e)	152
	Total Scope 2 (tCO2e)	171
	Total Scope 3 (tCO2e)	5,199
SF_6 Emissions	Total SF_6 Emissions 3 (tCO2e)	137

5.8 Cost Estimate

The cost of the preferred option for works at St Fergus Mobil has been developed using rates from existing substation framework contracts and benchmarks from delivered RIIO-T1 projects. The total cost for delivering the scope of works for the proposed solution is £12.7m.

6 Conclusion

This paper identifies the need for intervention on the 132kV switchgear at St Fergus Mobil substation. The primary drivers for this scheme are the asset conditions and network resilience.

Four intervention options were identified for this scheme. Of these, one option was taken forward and considered for detailed analysis.

The proposed scope of work selected (Option 3) is:

- Offline replacement of new indoor substation, including replacement of existing 132kV fluid filled cables,
- Additional two 132kV circuit breakers installed at St Fergus Switching Station.

This scheme will cost £12.7m and will delivers the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of -R£110m; see section 5 for details.
- A reduction of total network risk calculated as R£32m;
- Improved operational flexibility and resilience in line with our goal to aim for 100% transmission network reliability for homes and businesses; and,
- A reduction in the volume of SF_6 on the network from the use of innovative non SF_6 equipment contributing to our goal of a one third reduction in greenhouse gas emissions.

The scheme at St Fergus Mobil 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.

For our core non-load projects this means that we commit to delivering our overarching NARMs target. If we do not deliver the NARMS target, or a materially equivalent target, then we should be subject to a penalty. Equally, if we over-deliver against our target and are able to justify that the over-delivery is in the consumers interests and could not have been reasonably factored into our business plan at the time of target setting then we should be made cost neutral for this work.

Non-core non load projects should not be ring fenced. This is to allow for substitution of projects in order to meet that NARMs target. We need flexibility to respond to up to date asset data information or external influences on our network during the price control; this information might drive us to substitute one project for another in order to ensure a reliable and resilient network. Ring fencing projects may result in sub-optimal decisions, having adverse consequences for the health of our network, which will ultimately be reflected in the NARMs target.

8 Outputs Included in the RIIO-T1 Plan

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

Appendix A: Overall MITS Network Diagram

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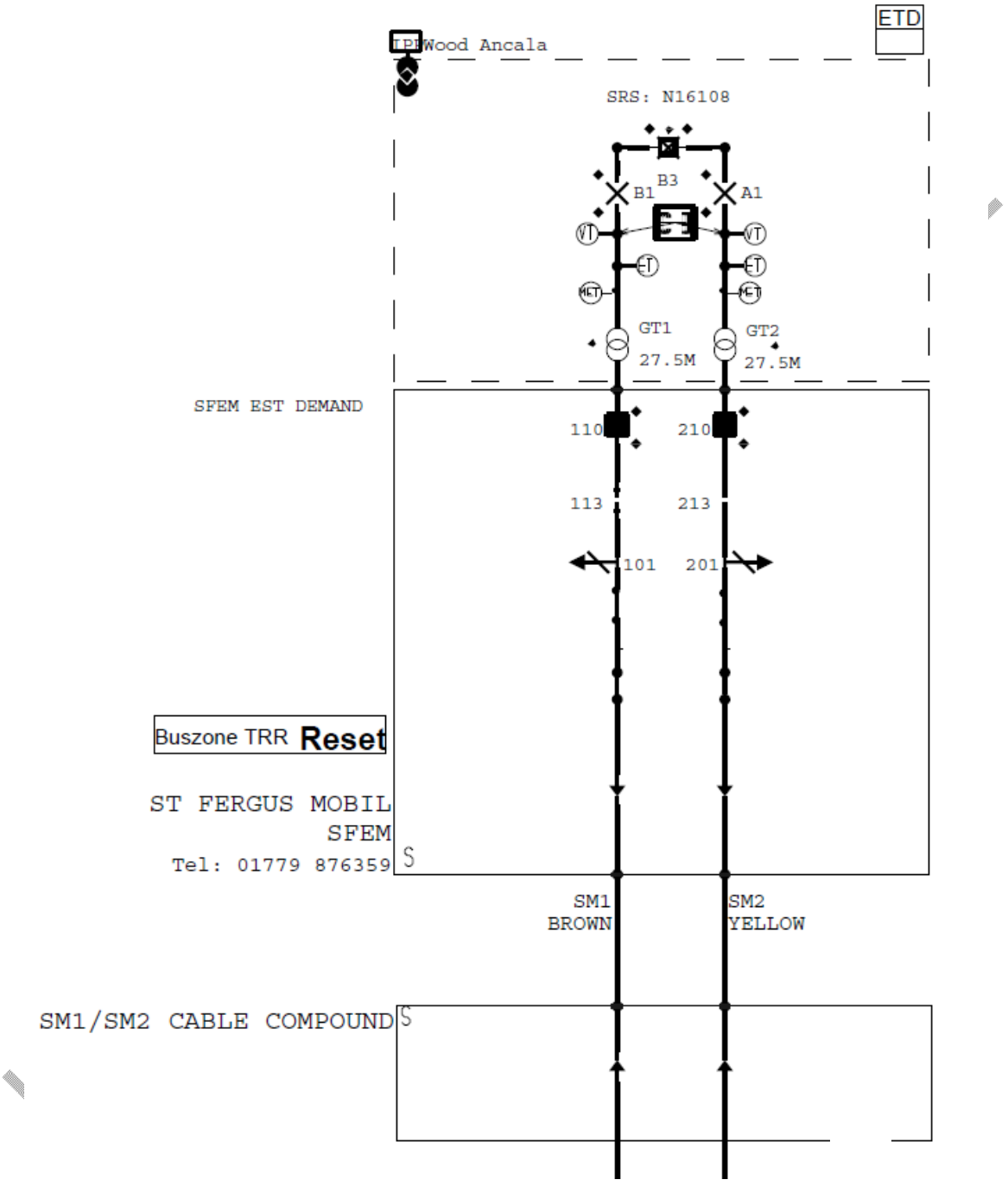
Appendix B: St Fergus Mobil Substation Network Configuration



Appendix C: SLD for St Fergus Mobil Works