Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan T2BP-EJP-0040

Quoich Tee 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 Quoich Tee switching station. The primary driver for the scheme is the asset condition with a secondary driver of network resilience.

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

- The replacement of the existing 132kV switchgear with a more operationally flexible configuration in a new location;
- The replacement of the existing LVAC, battery, and site diesel generation with a blackstart compliant system;
- The diversion of existing overhead lines to the new switching station location.

This scheme will cost £13.6m and deliver the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of -R£42.7m; see Section 5 for details.
- A reduction of total network risk calculated at -R£0.3m; see section 5 for details.
- The improvement of condition of our non-lead assets.
- Improved operational flexibility and resilience in line with our goal to aim for 100% transmission network reliability for homes and businesses.

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

[1] A Risk Based Approach to Asset Management

Name of Scheme/Programme	Quoich Tee Substation Works
Primary Investment Driver	Asset Health (Non-Load)
Scheme reference/ mechanism or category	SHNLT2013
Output references/type	NLRT2SH2023
Cost	£13.6m
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 Quoich Tee switching station the location of which is shown in Figure 1 on the next page.

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.

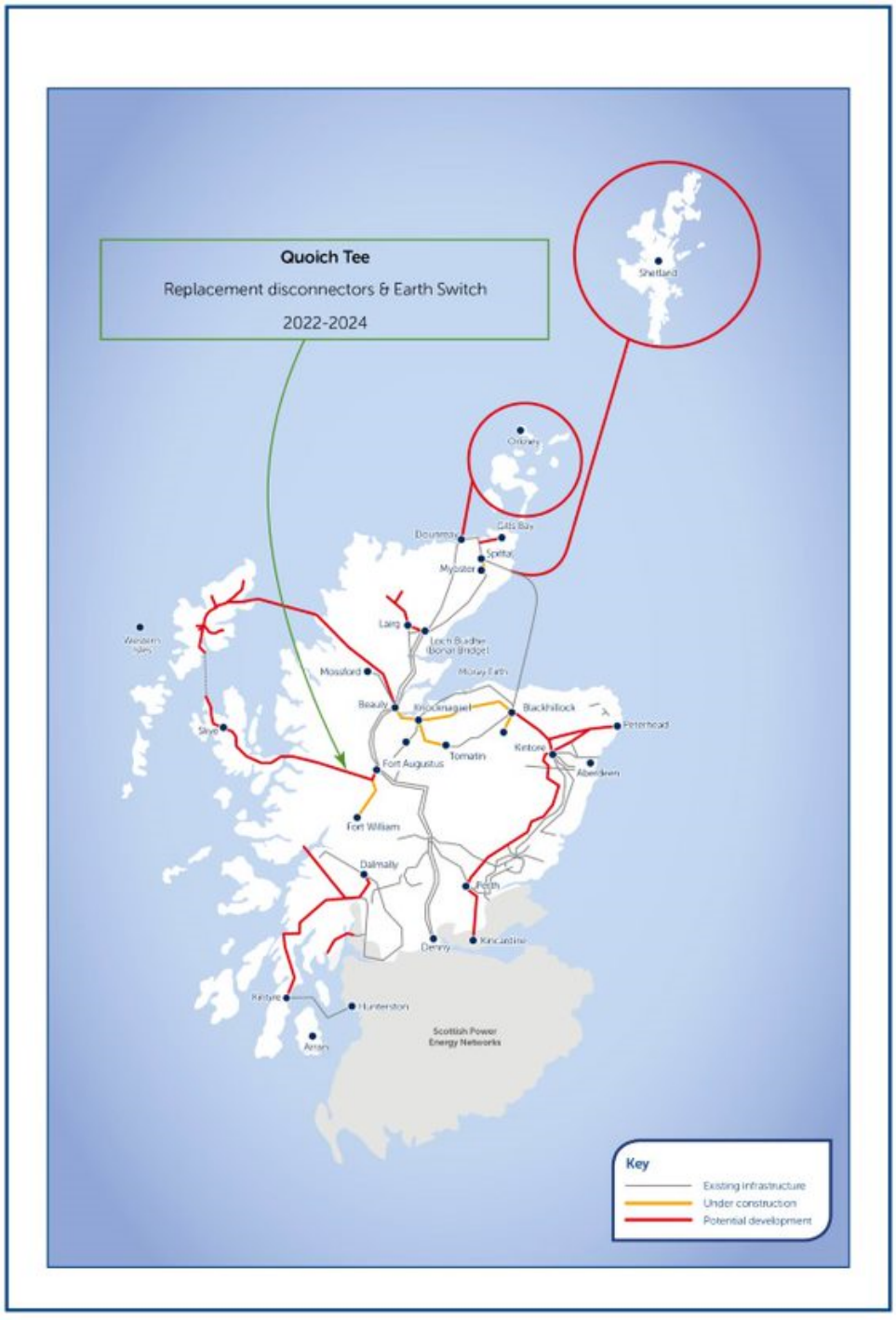


Figure 1: Geographical Representation

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.

3.1 Background

Quoich Tee switching station, which is situated to the north of Loch Poulary and east of Loch Quoich, is an important site on the 132kV network. An illustration of the network this switching station sits within is provided in Appendix A.

Quoich Tee forms one link in the chain along the circuit that provides the sole connection between Skye & the Western Isles and the Main Interconnected Transmission System (MITS). At the switching station itself there are two sets of isolators and earth switches to allow the isolation and earthing of the circuits running to Fort Augustus and Broadford (as illustrated in Appendix B).

[redacted]

3.2 Asset Need

A report containing all the historic condition information gathered on the Quoich Tee assets was compiled. The resulting 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 related issues are:

- The two disconnectors exhibit significant corrosion;
- The two earth switches exhibit significant corrosion;
- PLC line traps exhibit clear weathering and corrosion.

In addition to the condition-related issues outlined above, there are multiple operational limitations at the existing switching station:

- There is no switchgear that would allow the isolation of the overhead line running between Quoich Tee Switching Station and Quoich substation;

[2] Quoich Tee Substation Works Asset Condition Report T2BP-ACR-0015

- There is no CB or associated protection that would clear a fault on the overhead line running between Quoich Tee and Broadford thus ensuring Quoich substation would remain on supply;
- There is no CB or associated protection that would clear a fault on the overhead line running between Quoich Tee and Quoich substation to ensure a fault here does not disconnect the main Western Isles circuit;
- The 48V batteries onsite are not compliant due to being in the control room rather than a separate area. There are no 110V batteries present that would be needed for modern switchgear;
- The LVAC board and standby generator are insufficient to meet blackstart requirements;
- The site is only accessible on foot which limits access with equipment for maintenance;
- There are spares availability issues for assets onsite;
- Site communication for protection, SCADA, and telephony do not meet current standards.

3.3 Growth Need

There is no demand or generation directly connected at Quoich Tee switching station. Any works and associated outages would have to take into account the need to minimise disconnection of the Western Isles circuit and the associated requirement for the use of backup generators situated there. Another load driver to consider is the potential for future development of the Skye circuit due to the potential future customer connections in the area, which may bring about the need to modify or extend Quoich Tee switching station.

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 primary category identified is the need for 132kV single busbar intervention. A summary of the options is presented in the tables below:

Table 1: Options Summary

Option	Option Detail	Cost (£m)	Taken forward to Detailed Analysis?
1	Refurbishment of Existing Switchgear	N/A	No
2	In-situ rebuild	N/A	No
3	Offline rebuild	13.6	Yes

With regards to the interfacing projects that need to be taken into account when reviewing these options, any outages taken at Quoich Tee switching station for proposed works must be coordinated with the outages for Broadford, and Harris to Stornoway works.

Option 1

This option considers refurbishing the existing 132kV switchgear within the RIIO-T2 period. It is not considered a technically acceptable option for the site as the existing equipment has reached the end of its life, is increasingly becoming obsolete through a lack of spares, and lacks flexibility in terms of network isolation and fault clearance. It also fails to address the difficult site access, outdated communications equipment, and insufficient blackstart capability. It is therefore essential to upgrade this site within RIIO-T2 to ensure the long-term security of supplies to Skye and the Western Isles.

NOT PROGRESSED TO DETAILED ANALYSIS

Option 2

This option considers the installation of the new equipment within the footprint of the existing substation compound. This option has the following difficulties associated with it:

- It is not possible to achieve current engineering standards within the available area of ground, due to space constraints of the existing compound and the steep slopes that prevents further site expansion;
- Provision of an access track to allow safe access to the site would also be impractical as the surrounding land has too steep a gradient for access by wheeled vehicles.

Due to these constraints, this option is deemed impractical and has been discounted.

NOT PROGRESSED TO DETAILED ANALYSIS

Option 3

This option considers building a new site compound in a location relatively near to the existing site, ensuring that minimal diversion of the three overhead lines was required. An off-line build would allow:

- The outlined needs requirement to be met both from a network resilience as well as a condition perspective:
    - through providing space to build in CBs and associated protection to isolate faults in a way that keeps either the Western Isles main circuit or Quoich substation connected to the MITS;
    - through providing space to install an updated LVAC, battery, and diesel generation system in line with current standards and black start requirements;
- Reduction of the operational outage requirements to deliver the solution;
- Space for any future incorporation of a second circuit to Skye and the Western Isles.

The preferred location is situated to the west of the existing substation, close to the Quoich – Broadford 132kV tower line.

PROGRESSED TO DETAILED ANALYSIS

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.

5.1 Cost Benefit Analysis

A Cost Benefit Analysis (CBA) was not carried out due to Option 3 being deemed the only technically acceptable option as discussed in Section 4 above.

5.2 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 2: 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	We have considered the potential for a marginal further increase in generation on the wider Skye and Western Isles network and factored that into our analysis.
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 CBAs.
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.

5.3 Proposed Solution

The scope of the selected solution is to construct a new site to contain the new air insulated substation (AIS) switchboard. A copy of the Single Line Diagram (SLD) is shown in Appendix C.

Also included within the scope of works at the new switching station is the installation of a new LVAC system, 48V & 110V batteries, battery charger system, as well as a new diesel generator in order to satisfy modern design and black start standards. The scope also includes the diversion of the three existing overhead lines to this new site. The project will be energised with the RIIO-T2 period. The table below details the outputs.

Table 3: Outputs from preferred option

Plant	Size of new plant	Replacement for
132kV AIS switchboard	2x 132kV circuit breakers 6x 132kV disconnectors 5x 132kV earth switches	Existing 132kV AIS switchboard
Site services	48V & 110V batteries and chargers, LVAC, diesel generator	Equivalent systems at the old site
Overhead line diversions	9x 132kV supports & associated conductor 3x 132kV line gantries	Equivalent volume of 132kV supports, associated conductor and 132kV line gantries

5.4 Competition

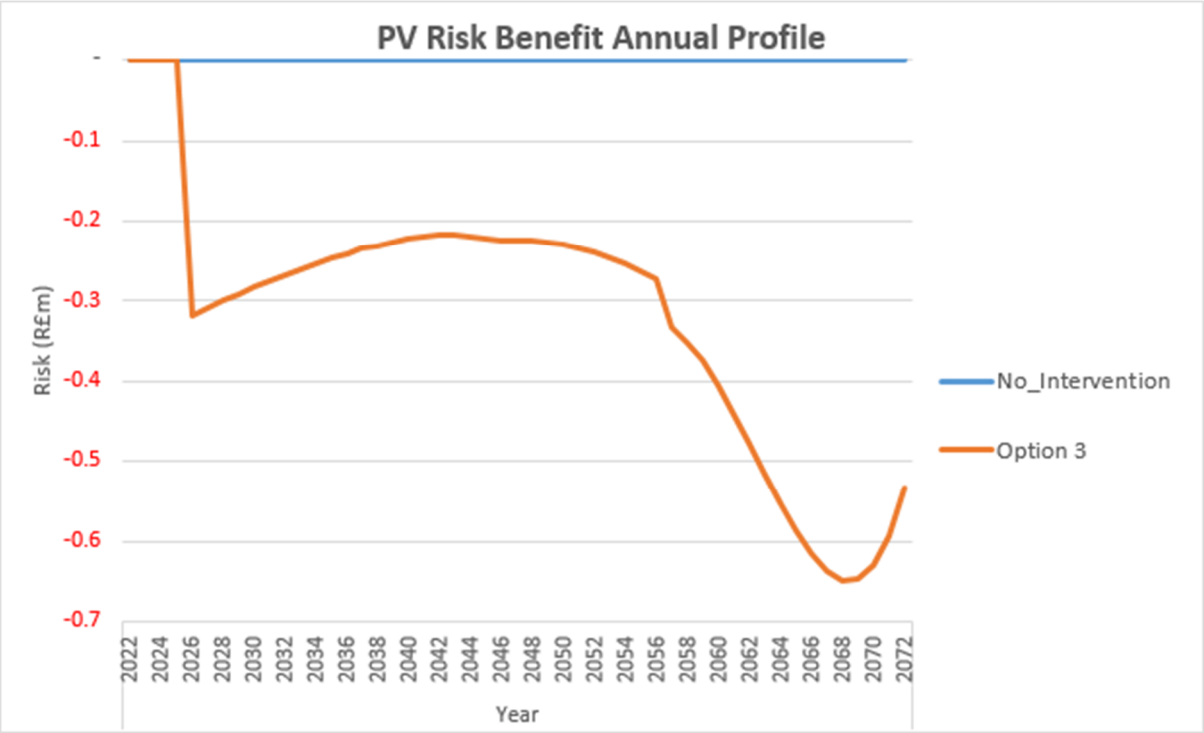
The Quoich Tee scheme is not flagged as eligible for early or late competition due the cost of the option being under Ofgem's £50m and £100m thresholds respectively.

5.5 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 risk monetised risk benefit which would be realised through the completion of this project is -R£42.7m. 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.

Figure 2: Long Term Benefit of Proposed Intervention – Offline Build of 132kV CBs and a new line connection to that station (Conductors, Fittings, Towers)



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£0.3m.

The reason for the negative value is that while the issues identified in the needs section are remedied by the solution, there are no lead asset CBs at the original site thus no modelled risk mitigation associated with completing the works. On completion of works there will be two lead asset CBs installed, [redacted]

5.6 Innovation & Sustainability

The proposed solution selected takes into account the need for further operational flexibility on the network in order to secure the Western Isles main line in the event of a fault on the Quoich substation circuit (and vice versa). This not only secures customer supplies more robustly but also minimises further the list of fault scenarios that would require diesel backup generation on the Western Isles to be used and thus minimising further the associated greenhouse gas emissions associated with this inefficient form of generation. The sustainability of this scheme is also enhanced by the minimal outages the selected option will require thus reducing the need for the backup generation further. The moving of the switching station to another location has also allowed for the selection of a site that

will allow future incorporation of a second circuit to Skye and the Western Isles, thus aiding a potential future scheme that would allow the connection of further renewable generation in the area.

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 for each option considered in our CBA through 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, these are captured in the carbon footprint results table below for the option selected for detailed analysis.

Table 4: 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	£ 260,861
	Construction	£ 458,433
	Operations	£ 39,206

	Decommissioning	£ 209,883
	Total Project Carbon Cost Estimate	**£ 968,384**
Carbon footprint tCO2e	Embodied carbon	3,483
	Construction	6,030
	Operations	171
	Decommissioning	603
	Total Project Carbon (tCO2e)	**10,288**
Project Carbon Footprint by Emission Category	Total Scope 1 (tCO2e)	86
	Total Scope 2 (tCO2e)	85
	Total Scope 3 (tCO2e)	10,116
SF_6 Emissions	Total SF_6 Emissions 3 (tCO2e)	68

5.7. Cost Estimate

The cost of the preferred option for works at Quoich Tee switching stations 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 £13.6m.

6 Conclusion

This paper identifies the need for intervention on the 132kV switchgear at Quoich Tee switching station. The primary driver for the scheme is the asset condition with a secondary driver of network resilience.

Three 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:

- The replacement of the existing 132kV switchgear with a more operationally flexible configuration in a new location;
- The replacement of the existing LVAC, battery, and site diesel generation with a blackstart compliant system;
- The diversion of existing overhead lines to the new switching station location.

This scheme will cost £13.6m and deliver the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of -R£42.7m, see Section 5 for details;
- A reduction of total network risk calculated at -R£0.3m, see Section 5 for details;
- The improvement of condition of our non-lead assets;
- Improved operational flexibility and resilience in line with our goal to aim for 100% transmission network reliability for homes and businesses.

The Quoich Tee scheme is not flagged as eligible for early or late competition due 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.

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 RIIO-T1 Plans

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

Appendix A: Overall MITS Network Diagram

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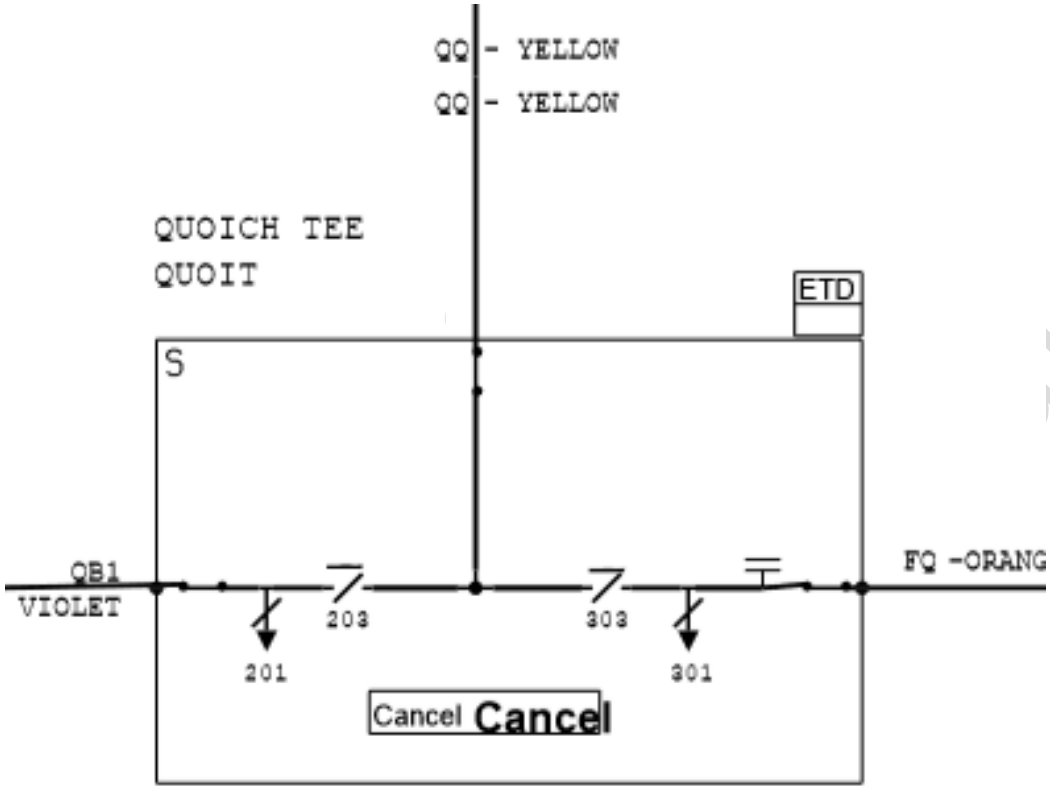
Appendix B: Quoich Tee Network Configuration



Appendix C: SLD for Quoich Tee Works