Scottish & Southern Electricity Networks

SSEN Transmission

RIIO-T2 Business Plan: T2BP-EJP-0038

Glenmoriston Substation Works

Core Non-Load

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 132/11kV transformer at Glenmoriston substation. The primary driver for the scheme is the asset condition.

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

- Offline replacement of the single 132/11kV transformer and associated ancillary plant.

This scheme will cost £5.7m and will deliver the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of R£28.4m,
- A reduction of total network risk calculated as R£1.6m,
- Improved operational flexibility and resilience in line with our goal to aim for 100% transmission network reliability for homes and businesses.

The Glenmoriston 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	Glenmoriston Substation Works
Primary Investment Driver	Asset Health (Non-Load)
Scheme reference/ mechanism or category	SHNLT2016
Output references/type	NLRT2SH2016
Cost	£5.7m
Delivery Year	RIIO T2
Reporting Table	C 0.7 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 Glenmoriston substation as shown on the map 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

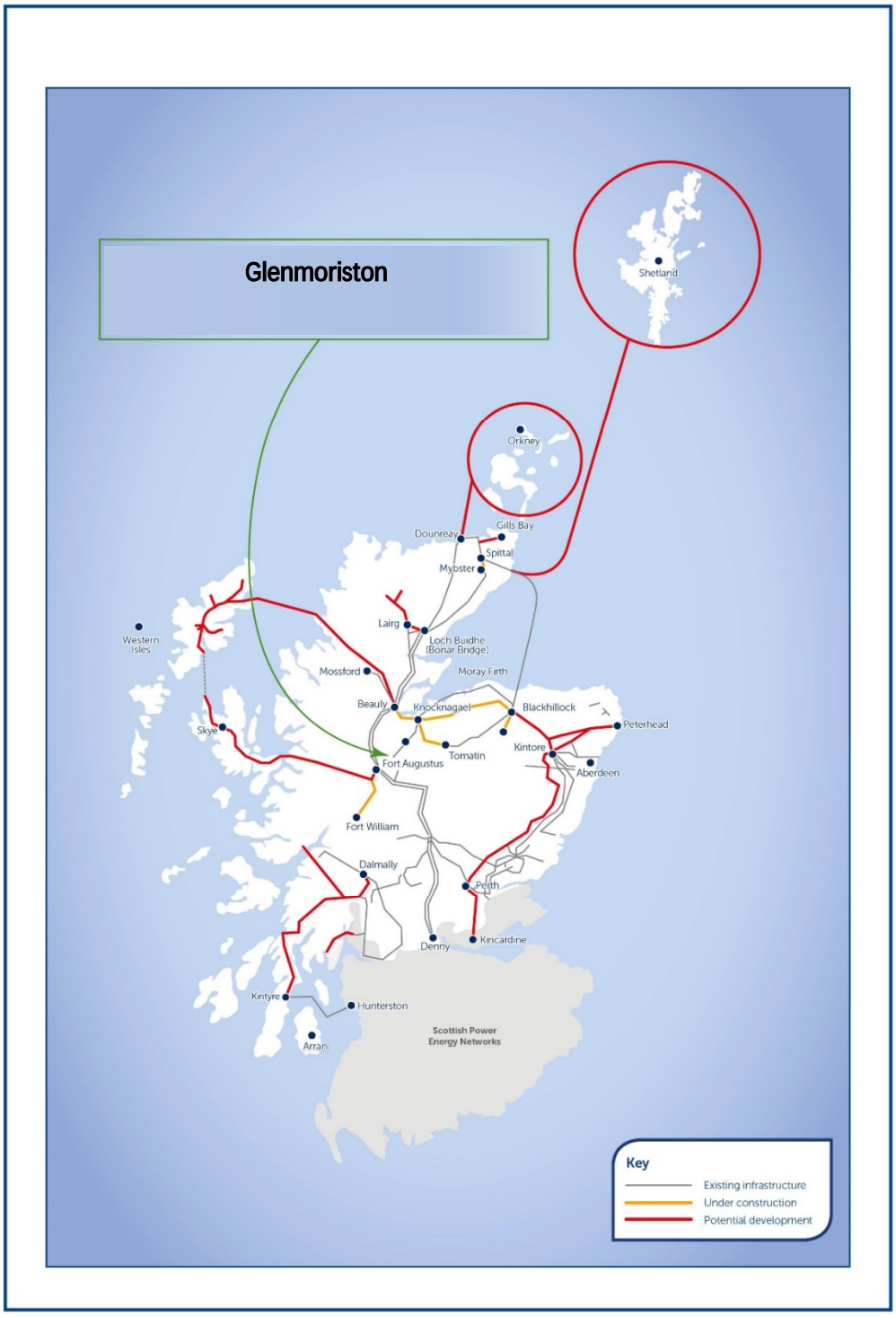
This section provides summary detail of the selected option. It sets out the scope and outputs, costs and timing of investment and where applicable other key supporting information.

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.


Glenmoriston
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

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

The Glenmoriston 132/11kV substation (built in 1957) is a single transformer site which facilitates the connection of Glenmoriston (37MW) and Livishie (15MW) Hydro generation units. The current transformer rating is 70MVA and there is no forecast increase required at this site.

3.2 Asset Need

The condition of the plant at Glenmoriston is recorded in the Glenmoriston Asset Condition Report[2]. The report shows that the transformer is showing signs of advanced paper insultation degradation and has therefore been identified for replacement during the RIIO T2 regulatory period.

The transformer was manufactured and installed in 1998, however oil analysis has shown an increasing furan trend indicative of advanced paper insulation aging. The analysis trends indicate rapidly increasing furans and gassing to excessive levels.

No other condition related issues have been identified at this site. Much of the 132kV plant and connections has been installed in the past two years during the works to connect Bhlaraidh wind farm in 2018.

Like other substations of this age and purpose, there are several ancillary assets which are either shared or are housed in shared space with the customer. In line with current engineering standards this scheme seeks to achieve business separation by replacing and re-housing the 11kV circuit breaker, batteries, protection and other associated items in a discrete transmission owned compound providing control over the maintenance and access to the asset. The recent wind farm connection works created a transmission control room and there is enough room in this building to house the separated assets.

3.3 Growth Need

A meeting was held on with the customer to discuss the portfolio of hydro generation schemes that would be affected by our works during the RIIO T2 period. This confirmed that the generation sites exporting through Glenmoriston have no plans for increasing their output in the foreseeable future.

[2] Glenmoriston Asset Condition Report T2BP-ACR-0028

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 replacement of this unit is being driven by deteriorating asset health[2]. There is also a requirement for an upgrade of the transformer bund arrangement and auxiliary assets to align with current engineering standards and to achieve satisfactory business separation. This transformer is showing signs of advanced ageing and is approaching the end of expected asset life; therefore, a replacement unit is deemed necessary.

The option of further deferral of asset replacement works has not been considered, primarily as a result of the reported asset health. Furthermore, asset refurbishment is not considered a technically viable solution, due to both the asset health and need for additional site upgrades. It is also worth noting that removal of the asset is not acceptable since the hydro schemes require continued connection in the transmission network.

A 70MVA transformer (with an 11kV secondary) is a non-standard GT size, the replacement transformer will be a bespoke unit for this site

Table 1 – Options Considered

Option	Option Detail	Cost (£m)	Taken forward to Detailed Analysis?
1	In-situ replacement	-	No
2	Offline Build	5.7	Yes

Option 1

This option is an in-situ replacement of the GT. However, replacing the transformer in the same location does not meet fire damage zone requirements.

A new circuit switcher with a combined rated earth switch is proposed as part of the busbar feeder upgrade. Also, as the control building which was recently built during the Bhlaraidh Windfarm connection project has only partially utilised the total space available, this RIIO-T2 project will be able to relocate SHET assets (such as 11kV circuit breakers, Protection cubicles and batteries) into this control building. The aim of this change would be to minimise reliance on shared assets which are presently situated within the generation station, whilst also supporting the aims of full business separation.

In order to facilitate an in-situ GT replacement there will have to be a significant generator outage at the nearby Hydro power stations of Glenmoriston and Livishie, as these two generators rely on the existing GT asset for a grid connection. The estimated period to deliver this work under outage conditions is approximately 6 months.

It is worth noting that the work can be carried out without necessitating a similar outage on the nearby Bhlaraidh Windfarm, which connects to the grid via the 132kV busbar at Glenmoriston substation. Site inspections with the operational team has confirmed that work could be undertaken to upgrade the transformer bund and other civil aspects, without an outage on the FM (Glenmoriston to Fort Augustus) or ML (Bhlaraidh Windfarm to Glenmoriston) 132kV circuits.

This option is not technically acceptable as the fire damage zones cannot conform to current engineering standards, and this solution would require very long customer outages to complete.

NOT PROGRESSED TO DETAILED ANALYSIS

Option 2

For an offline build, the required outages are minimal in comparison to the in-situ approach. However, there are also some additional challenges which are presented by the offline build, including:

- Limited space for new land acquisition, with only one possible area of land available,
- Interface issues with existing compound, including the requirement for existing Bhlaraidh 132kV windfarm cable to be re-routed to avoid crossings with the new GT cables.

A new circuit switcher with a combined rated earth switch is proposed as part of the busbar feeder upgrade. Also, as the control building which was recently built during the Bhlaraidh Windfarm connection project has only partially utilised the total space available, this RIIO-T2 project will be able to relocate SHET assets (such as 11kV circuit breakers, Protection cubicles and batteries) into this control building. The aim of this change would be to minimise reliance on shared assets which are presently situated within the generation station, whilst also supporting the aims of full business separation.

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

There is only one technically acceptable option to address the asset condition of the transformer at Glenmoriston and that is the replacement offline in a compound next to the existing substation. Since there is only one acceptable solution Cost Benefit Analysis has not carried out.

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: The asset performance / deterioration rates can only improve or deteriorate. As the need for this project is driven by an asset condition report (as outlined in Section 3), the asset condition will not improve in the intervening period. The second option is for the asset performance to deteriorate and therefore the need remains, and the 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,

	only one option was taken forward to detailed analysis and therefore there is no impact on the preferred solution.
Demand variations	No significant demand forecast
Energy scenarios	Sensitivity considered in Section 3 (Need) already. As this is a non-load project and the need is driven by the asset condition, the work would be required regardless of any changes to the energy scenarios.
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 as part of section 5 (Detailed Analysis) 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 (section 3), optioneering (section 4) and detailed analysis (section 5) and the impacts this has on the selection of the preferred solution. For example, the projects have considered the impact of the UK Governments' Net Zero emission by 2050 target, SQSS and ESQCR.

5.3 Proposed Solution

The scope of the selected solution is to an offline replacement of a 132/11kV transformer and associated ancillary plant. 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
132/11kV transformer and ancillary plant	90MVA transformer 11kv circuit breaker 132kV Circuit switcher	70MVA transformer - -

In recognition that this unit is failing at an advanced rate, the transformer will be recovered from site and will be subjected to forensic inspection to determine the cause of its failure.

5.4 Competition

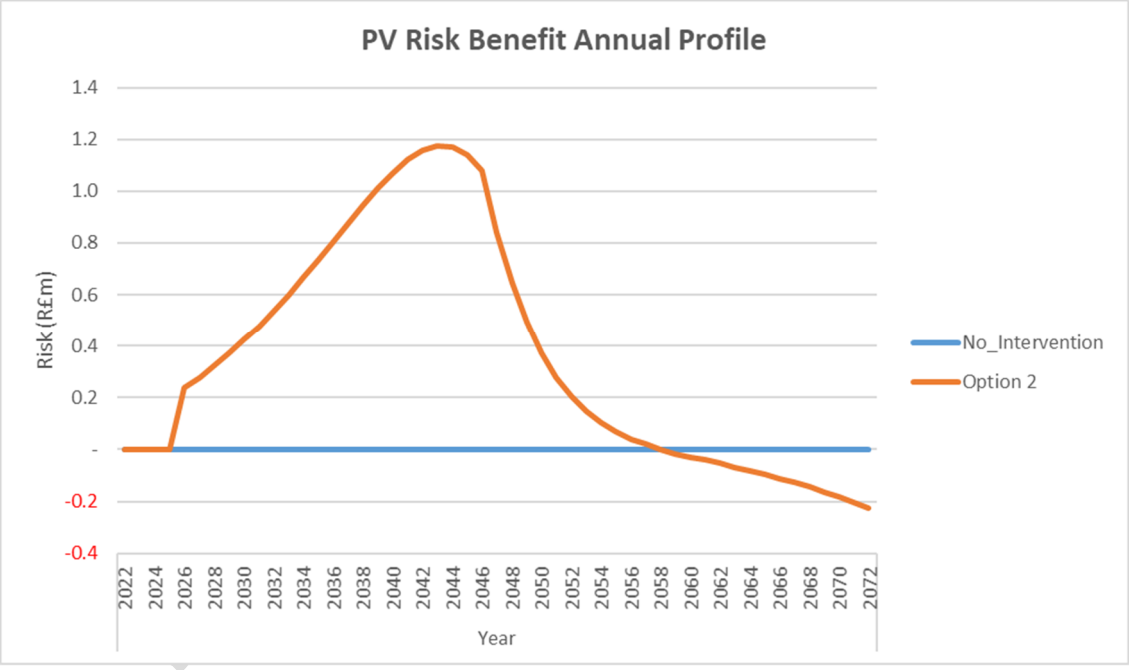
The Glenmoriston scheme is not flagged as eligible for early or late competition due it being under Ofgem's £50m and £100m thresholds respectively

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 benefit which would be realised through the completion of this project is R£28.4m. 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 – Transformer Replacement



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£1.6m.

5.6 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.

The results of analysis for this project are captured in the carbon footprint results table.

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	£ 23,034
	Construction	£ 3,381
	Operations	£ -
	Decommissioning	£ 1,548
	Total Project Carbon Cost Estimate	**£ 27,963**
Carbon footprint tCO2e	Embodied carbon	308
	Construction	44
	Operations	-

	Decommissioning	4
	Total Project Carbon (tCO2e)	**356**
Project Carbon Footprint by Emission Category	Total Scope 1 (tCO2e)	-
	Total Scope 2 (tCO2e)	-
	Total Scope 3 (tCO2e)	356
SF_6 Emissions	Total SF_6 Emissions 3 (tCO2e)	-

5.7 Cost Estimate

The cost of the preferred option for works at Glenmoriston 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 £5.7m.

6 Conclusion

This paper identifies the need for intervention on the 132/11kV transformer at Glenmoriston substation. The primary driver for the scheme is the asset condition.

The proposed scope of work selected is:

- Offline replacement of the single 132/11kV transformer and associated ancillary plant

This scheme will cost £5.7m and will deliver the following outputs and benefits during the RIIO T2 period:

- A long term monetised risk benefit of R£28.4m,
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The Glenmoriston 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 delivered during the RIIO T1 period.