# U & AT Routes 132kV Replacement

## Route Strategy EJP
## Version: 1.1
## 11/12/2024

SP Energy Networks
RIIO-T3 Business Plan

<table>
<tr><th colspan="4">U & AT ROUTES 132kV REPLACEMENT</th></tr>
<tr><td>Name of Scheme</td><td colspan="3">SPT-RI-151b U & AT Route 132kV Replacement</td></tr>
<tr><td>Investment Driver</td><td colspan="3">Asset Health/Load Enabling</td></tr>
<tr><td>BPDT / Scheme Reference Number</td><td colspan="3">SPT200248</td></tr>
<tr><td>Outputs</td><td colspan="3"><ul><li>59.4km 132kV OHL (Tower Line) Conductor Rating <352MVA (Addition)</li><li>40.38km 132kV OHL (Tower Line) Conductor Rating <89MVA (Disposal)</li><li>132kV Overhead Line Fittings – 148 (Replacement)</li><li>132kV Overhead Line Fittings – 168 (Disposal)</li><li>132kV Overhead Tower Line – 124 (Addition)</li><li>132kV Overhead Tower Line – 134 (Disposal)</li><li>132kV Overhead Pole Line – 124 (Disposal)</li><li>21.62km 132kV Overhead Pole Line Conductor (Disposal)</li><li>2.4km 132kV Circuit Cable – 1 core per phase (Addition)</li></ul></td></tr>
<tr><td>Cost</td><td colspan="3">£66.26m (23/24)</td></tr>
<tr><td>Delivery Year</td><td colspan="3">2030</td></tr>
<tr><td>Applicable Reporting Tables</td><td colspan="3">BPDT (Section 5.1 Project Meta Data, Section 6.1 Scheme C&V Load Actuals and Section 11.10 Contractor Indirects)</td></tr>
<tr><td>Historic Funding Interactions</td><td colspan="3">U and AT route uprating (RIIOT2 EJP Ref EJP_SPT_SPNLT20129)</td></tr>
<tr><td>Interactive Projects</td><td colspan="3">N/A</td></tr>
<tr><td rowspan="2">Spend Apportionment</td><td>ET2</td><td>ET3</td><td>ET4</td></tr>
<tr><td>£1.66m</td><td>£64.60m</td><td>£0m</td></tr>
</table>

## Table of Contents

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## 1. Executive Summary

This engineering justification paper (EJP) sets out the needs case for:

- Full replacement of the existing U & AT routes between Galashiels 132kV and Eccles 132kV substations by installation of a new route, DW route, consisting of L7 132kV towers with twin UPAS conductor.

The drivers behind this project entail:

- Asset condition requires major intervention on existing U&AT Routes within RIIO-T3 period.
- Facilitate the connection of new renewable energy generation in the area.
- Support SPD in the forecasted increase in demand connections to come onto the network within the RIIO-T3 period and beyond.

This scheme will allow SP Transmission (SPT) to replace the existing 132kV U & AT route circuits between Galashiels 132kV and Eccles 132kV substations in the South East of Scotland with a new single route, DW route. Due to the current condition of the towers and wood poles on both U & AT route, a full replacement is required with the proposed works to be completed within the RIIO-T3 period. These works will also allow SPT to uprate the circuit between Galashiels 132kV and Eccles 132kV substations using twin UPAS conductor, enabling the accommodation of contracted generation in the area.

The expected project delivery date for the works is 2030 and the forecast cost is £66.26m.

This EJP is submitted for Ofgem's assessment of the need case for the project and the selection of the preferred option in order to provide sufficient funding for pre-construction and early construction activities. A cost assessment submission will be made to Ofgem through the RIIO-T3 Load Related Reopener at an appropriate time.

## 2. Introduction

This EJP supports a proposal to carry out a full replacement of the U & AT route, between Galashiels and Eccles 132kV substations, with a new 132kV steel tower double circuit route (named DW Route) within the RIIO-T3 period.

U & AT Routes are 132kV Overhead Lines (OHL) between Galashiels 132kV Substation and Eccles 132kV Substation (Gala – Eccles 132kV), spanning a total of approximately 31km in length, as shown in Figure 1. The Gala – Eccles 132kV overhead line circuits originated in 1932 as a single circuit line using the PL-1 suite of towers (U Route). A second single circuit line (AT Route) was added in 1965 utilising a 'Portal design' (intermediate wood poles, steel tower tension towers). Line entries at the substations are on double circuit towers at Gala (P Route) and Eccles (AT Route) which were built in 1932 and 1965, respectively. Very few interventions have taken place on any section, but insulators have been replaced in the past as required.

In the area surrounding the Galashiels and Eccles substations, there has been an increase in the number of contracted generators scheduled to connect during the RIIO-T3 period that require an increase in the capacity of U & AT routes, detailed within SPT-RI-151b, as enabling works. The majority of these connections are onshore wind and battery storage. In order to accommodate this increase, the capacity of the electrical infrastructure needs to be increased. Ensuring that the U & AT routes are uprated to an appropriate capacity in order to accommodate these new connections, as well as future strategic reinforcement in the area, is therefore vital in ensuring SP Transmission continues to work towards achieving the Scottish Government target of reaching net zero by 2045. This reinforcement scheme also responds to the SP Distribution (SPD) requirement to uprate the electricity network in the area to support their contracted generation and demand, as SPT's connected distribution network operator (DNO).

The most recent aerial condition assessment reports for both U & AT routes, conducted in August 2017, indicates the need for intervention on both routes due to the deterioration of insulators, fittings and tower foundations. The assessment, a visual inspection of the towers conducted using high resolution digital still imaging captured from an aerial view using a helicopter, showed significant degradation in the structure of a number of towers and poles along both routes.

In 2019 a detailed inspection of both U and AT routes was carried out by Energyline on behalf of SPT. On AT route this focused on pole health using a variety of testing methods. Of the 26 poles tested, visual and hammer tests showed some level of decay at all poles with scores of CR3 or CR4. The "CR" scoring system is utilised by the external reviewer to reflect the current condition of the monitored asset. The scale ranges from CR1-CR5, with CR1 being the best and requiring no intervention and CR5 being the worst, requiring immediate intervention in the near future. The assessment of U route steel towers showed that while the towers are in relatively good condition for their age, significant tower and foundation strengthening would be required to deploy a larger conductor system on the supports whilst meeting current design codes of practice.

Further, failures of insulators along AT route in the preceding years and since the condition assessment have also acted as a driver for the necessity to complete the works during the RIIO-T3 price control period. Given the poor condition of the routes as shown in the condition assessments detailed in Section 3.3, a full replacement of the line is seen to be the most economically viable solution. If the existing capacity was sufficient for future needs, then the most economically viable solution would be to replace the circuits with wood pole trident lines. However, with the increased in capacity contracted to connect to the network in the surrounding area during the RIIO-T3 period, this option would not provide sufficient future capacity. Alternatives that will allow for the required rating have been explored.

The conclusion of the condition assessment, along with consideration of the future need to increase circuit capacity on the 132kV system in the area, combine to represent a primary driver for replacement works on the route.

These circuits were identified within the RIIO-T2 period under non-load EJP (EJP_SPT_SPNLT20129) for full rebuild using a like for like conductor. Given the uncertainty of generation requirements in the area, this non-load project was ultimately cancelled and SPT-RI-151b created to ensure the load elements of the project could be captured accordingly. Further analysis on the uncertainty surrounding the increase of generation connections in the area was carried out using the TECA scoring system as detailed in Section 3.1. Whilst a delay to allow for greater certainty around capacity requirements was required, the asset condition now means that this project must be completed within the RIIO-T3 period.

The proposed scope and specific timing are driven by the contracted generation scheduled to connect to the network in the area. The scope of this project was initially to rebuild the 132kV route between Galashiels and Eccles with L7 steel towers and install Poplar conductor giving each circuit a summer pre-fault rating of 124MVA. Following the signing of [redacted], which is contracted to connect [redacted], the scope of works has been reviewed and revised to use twin UPAS conductors. This will provide 310MVA on each 132kV circuit (total of 620MVA) and this makes up the current scope of the work proposed in this EJP (SPT-RI-151b). A geo-schematic diagram of circuits U and AT routes is provided in Figure 1.

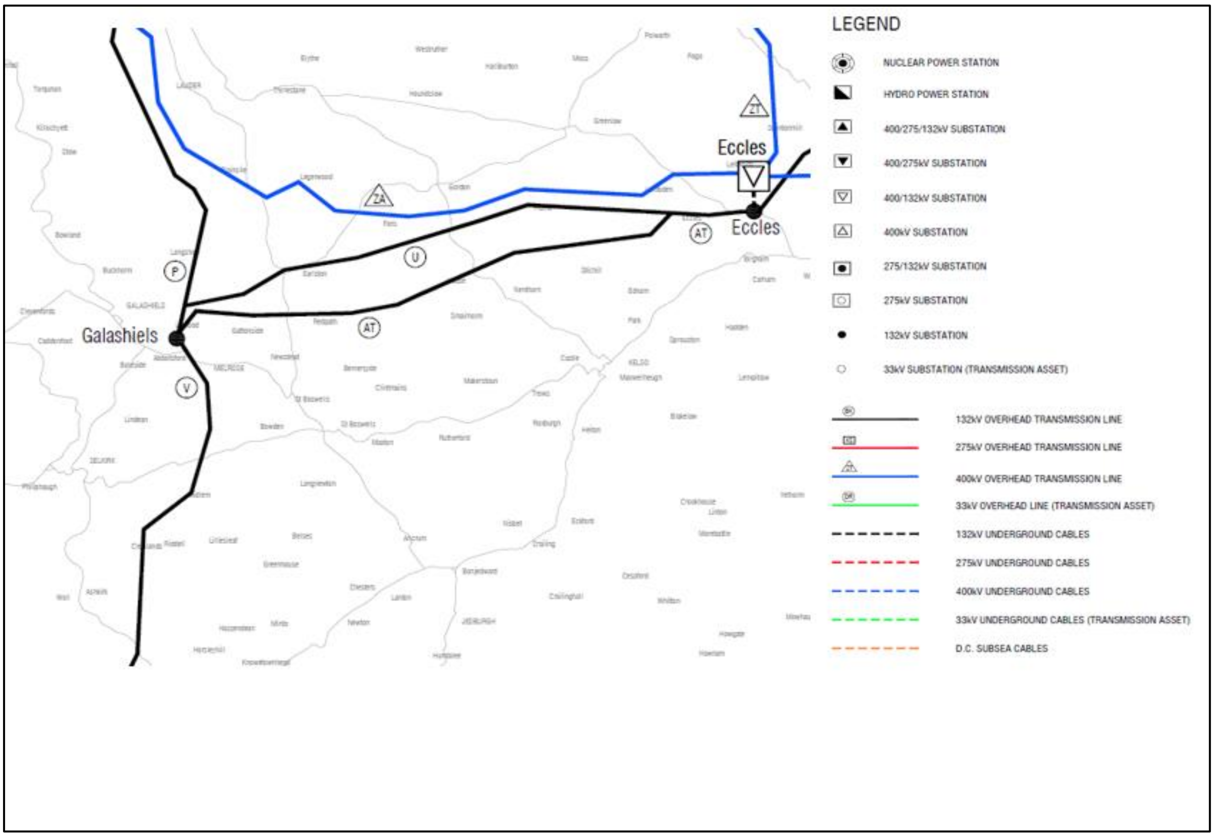


**Figure 1: U & AT Route extract from Networks Diagram Geographical Layout**

The current contracted date for the delivery of this project is September 2028, when the new DW route will be completed. U & AT routes will then be dismantled, with the final works being completed by the end of 2029. The total cost estimate for this project is £66.26m (2023/24).

This EJP is submitted for Ofgem's assessment of the need case for the project and the selection of the preferred option to provide sufficient funding for the pre-construction and early construction activities. A full cost submission will be made at the appropriate time.

## 3. Background Information

U & AT routes are two single circuit overhead lines that provide a double circuit connection between Galashiels 132kV substation and Eccles 132kV substation, spanning approximately 31km in length per circuit.

U route is a single circuit comprised of 93 steel lattice towers of SSPL1 construction type constructed in 1932. The route starts from Galashiels in a North-East (NE) direction before changing to an easterly direction part way along the route, passing mostly through agricultural land for most of the route. There is one operating circuit on this route: Galashiels-Eccles-1 (GALA-ECCL-1). The route consists of ACSR 175mm$^2$ 'Lynx' phase conductors, ACSR 70mm$^2$ 'Horse' earth-wires with glass insulators which were installed in 1969. There is currently no optical fibre installed on the route.

AT route was constructed in 2 sections: 1959 (AT001-AT149 and AT165) and 1965 (AT150-AT164). It comprises 126 wooden 'H' poles and 41 steel lattice towers of which 26 are of flat single circuit construction type and 15 are of PL16 construction type. The route runs in an east-north-east direction, passing mostly through agricultural land for most of the route. There are 2 operating circuits on this route: Galashiels-Eccles-1 (GALA-ECCL-1) and Galashiels-Eccles-2 (GALA-ECCL-2). The route consists of ACSR 175mm2 'Lynx' phase conductors which were installed from AT001-AT149 in 1959 and AT150-AT165 in 1965. Glass insulators were installed on the route from AT001-AT150 in 1959 and AT151-AT165 in 1965. ACSR 70mm$^2$ 'Horse' earth-wire was installed from towers AT151-AT165 in 1969 with no optical fibre currently installed on the route.

Information on the existing U & AT routes and the proposed options are summarized in Table 1.

**Table 1: Existing U & AT Route Information**

| **System Design Table** | **Circuit / Project** | **Option 1 Baseline:** *Do Nothing / Minimum* | **Option 2:** *Reconductor Existing Towers* | **Option 3:** *Full replacement 132kV L4 Towers RIIO-T3* | **Option 4:** Full replacement with LARK conductor | **Option 5:** Full replacement L7 Towers 132kV single UPAS RIIO-T3 | **(Proposed) Option 6:** *Full replacement L7 Towers 132kV twin UPAS RIIO-T3* | **Option 7:** Underground Cable Route |
|---|---|---|---|---|---|---|---|---|
| **Thermal and Fault Design** | Existing Voltage *(if applicable)* | 132kV | 132kV | 132kV | 132kV | 132kV | 132kV | 132kV |
| | New Voltage | N/A | 132kV | 132kV | 132kV | 132kV | 132kV | 132kV |
| | Existing Continuous Rating *(if applicable)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* | 89MVA @ 50ºC *(Summer Pre-fault)* |
| | New Continuous Rating | N/A | 227MVA @ 75ºC *(Summer Pre-fault)* | 176MVA @ 75ºC *(Summer Pre-fault)* | 227MVA @ 75ºC *(Summer Pre-fault)* | 176MVA @ 75ºC *(Summer Pre-fault)* | 286MVA @ 75ºC *(Summer Pre-fault)* | 282.8MVA @ 75ºC *(Summer Pre-fault)* |
| | Existing Fault Rating *(if applicable)* | N/A<br>N/A | | | | | | |
| | New Fault Rating | | | | | | | |
| **ESO Dispatchable Services** | Existing MVAR Rating *(if applicable)* | | | | | | | |
| | New MVAR Rating *(if applicable)* | | | | | | | |
| | Existing GVA Rating *(if applicable)* | | | | | | | |
| | New GVA Rating | | | | | | | |
| | Present Demand *(if applicable)* | 86MW | 86MW | 86MW | 86MW | 86MW | 86MW | 86MW |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **System Requirements** | 2050 Future Demand | 115MW[1] | 115MW | 115MW | 115MW | 115MW | 115MW | 115MW |
| | Present Generation *(if applicable)* | 80.1MW | 80.1MW | 80.1MW | 80.1MW | 80.1MW | 80.1MW | 80.1MW |
| | Future Generation Count | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| | Future Generation Capacity | 585MW[2] | 585MW | 585MW | 585MW | 585MW | 585MW | 585MW |
| **Initial Design Consideration** | Limiting Factor | Asset health driven requirement | N/A | Limit on thermal capacity | Limit on thermal capacity | Limit on thermal capacity | N/A | Increased Costs |
| | AIS/GIS | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | Busbar Design | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| | Cable/OHL/Mixed | N/A | Mixed | Mixed | Mixed | Mixed | Mixed | Mixed |
| | SI | N/A | Selected conductor for new circuit larger than minimum requirement for future reinforcement | N/A | N/A | N/A | N/A | N/A |

1 Value attained from Future Energy Scenarios 2024
2 Value attained from SPT TECA

## 3.1. System Reinforcement Drivers

Within the RIIO-T3 price control period, 1st April 2026 – 31st March 2031, there are a considerable number of new generation projects contracted to connect to the SPT network, with a substantial proportion of this new generation comprising on- & offshore wind and battery energy system storage (BESS).

In the most recent (2024) Future Energy Scenario (FES) developed by the NESO, the Holistic Transition (HT) scenario indicates the connection of 13GW of wind & 3.99GW of battery storage by 2031 in the SPT area at the end of the RIIO-T3 period. These figures extend to 16.5GW for onshore wind plus offshore wind by 2050, with battery storage remaining at 3.99GW respectively.

Based upon the current contracted queue for directly-connected transmission connections being significantly greater than the FES requirements, as outlined in the TEC register, it is vital that SPT is proactive in the approach to the replacement of ageing circuits on the network in order to provide an efficient and economic opportunity to reduce the risk of being unable to meet future generation connection.

On the 4th November 2024, NESO published the 'Clean Power 2030' paper as advice to the UK Government on how to achieve a low-carbon power system by 2030 where demand is met by clean sources (primarily renewables) with gas fired generation only to be used to ensure security of supply (primarily during periods of low wind). While subject to a decision by the UK Government, this publication reaffirmed the need to continue to invest in the wider transmission network to ensure that 2030 and later targets are met.

### 3.1.1. New Generation Connections

A Bilateral Connection Agreement is in place between the NGESO and the developers of the generation projects detailed in Table 2. In each case, the U & AT Route rebuild project is identified as enabling works corresponding to Transmission Owner Construction Agreements that are in place between the NGESO and SPT.

**Table 2: Contracted Connections Priority Scores Table**

[redacted]

[redacted]

| | | | | |
|---|---|---|---|---|
| **Total Capacity (MW)** | - | - | - | **835.9** |

***TECA Legend***

| TECA Probability | Designated Colour |
|---|---|
| High | |
| Medium | |
| Low | |

During the process of identifying and evaluating options for each connection offer, due regard has been given to the development of an efficient, coordinated and economical system of electricity transmission. As well as determining the most appropriate connection location and connection method (e.g. overhead line, underground cable, wood pole versus steel tower, connection voltage etc).

As a part of the T3 load planning strategy, SPT has developed a probability scoring system, in order to score directly connected transmission projects based on parameters that will indicate their likelihood to connect to the network by their intended connection date. This is used to inform requirements of network reinforcements. By utilising this tool, a portfolio of generation connections that have a high probability of connecting to the network in the near future can be built, enabling SPT to take a proactive approach when considering future reinforcement works on the network.

Identifying areas that have a substantial number of generation connections scheduled to connect to the network, with a corresponding high probability score, has helped to shape the SPT RIIO-T3 plan.

This approach has been used in advance of the outcome of the Connections Reform, which will use similar assessment criteria to determine the requirements and resulting connections to the system. We do not anticipate that the requirement for or scope of this project will be impacted by the outcomes of Connections Reform due to the use of TECA.

The overall priority rating is determined from (weighted) scores in four project-specific and technology type categories. The four categories are as follows:

- Technology

[redacted]

- Technology Maturity
- Developer Track Record
- Planning Status

Analysis of the available data indicates that there is significant confidence that just under half of the projects that have these works listed as enabling works set out in this EJP (SPT-RI-151b) will connect to the network, based on those categorised as high and medium probability to progress these works. This would indicate an increase of 356MW being added to the network that are reliant on the enabling works set out in this paper. When including all (lower probability) connections, this total increases to 835.9MW.

Given the target set by the Scottish government to reach net zero by 2045, it is vital that the necessary electrical infrastructure to support the connection of new renewable generation is completed within the upcoming RIIO-T3 period and beyond. The timely and efficient delivery of network infrastructure, such as the investment outlined in this document, will provide the increase in circuit capacity required to support the connection pipeline of low carbon technology projects. Without this reinforcement, the equipment on the network will not have the necessary rating/capacity to accommodate the predicted generation to come on to the network; causing SPEN to fall behind on its commitments to net zero as dictated by current government targets.

### 3.1.2. SP Distribution Support

During the RIIO-T3 period there is forecast to be an increase in the amount of generation and demand connections contracted to the SP Distribution (SPD) network. Data provided by the latest DFES report forecasts that demand across Scotland will increase, without flexibility, by as much as 44% by 2035 and nearly double by 2050.[5]

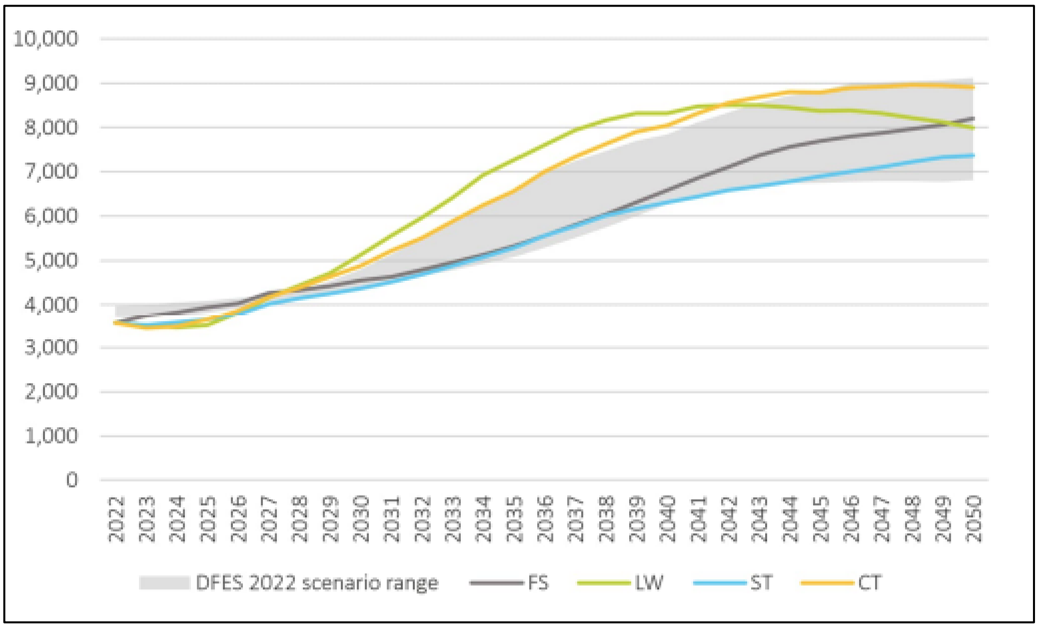


**Figure 2: Forecasted Electricity Peak Demand without flexibility**

[5] DFES 2023 Report

The data presented in Figure 2 shows the forecasted range in Peak Demand (difference between highest and lowest scenario) from the 2022 DFES against the current data from the DFES 2023.Acronyms in the above align with the scenarios used by the NESO in FES 2023, where: FS is Falling Short, LW is Leading the Way, ST is System Transformation and CT is Consumer Transformation.

This is expected to result in an associated increase in the number of generation projects, fault level issues and demand constraints at the distribution level that may require work on the SP transmission network. These constraints are based on the DFES forecast with respect to accepted generation and demand connections scheduled to energise during the RIIO-T3 period.

One of the areas that is forecast to require SP Transmission works before 31 March 2031, in order to alleviate fault level and increase generation capacity  is the area surrounding the Galashiels 132kV substation, as seen in Figure 3.

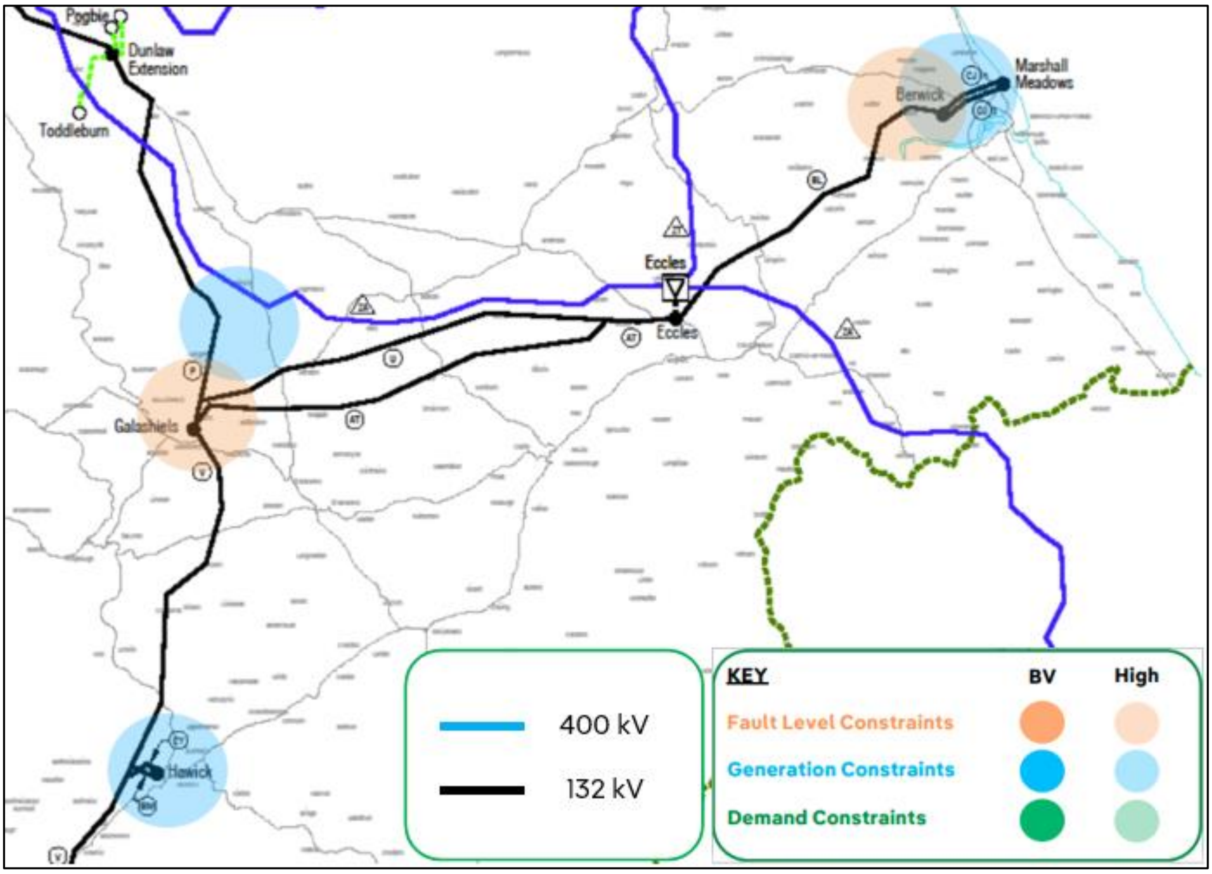


**Figure 3: SPD Fault Level, Generation and Demand Constraints**

The increase in generation and demand connections in the area surrounding Galashiels has resulted in the requirement for the installation of a new GSP in the area to support these new connections. The completion of the works to rebuild the U & AT route will support the establishment of a new GSP in the area as a direct result of the increased capacity available from the new route.

## 3.2. Future Development

The works proposed in this paper will modernise the tower and conductor system on the route as well as provide a thermal capacity uplift.

This is the first step in the development of the local system. Further projects are planned to establish a new 400/132kV substation in the Galashiels area (Gala North substation) and new 400kV and 132kV circuits to provide significant reinforcement to the area beyond the proposed works.

The new Gala North 400kV substation will be constructed under SPT-RI-2079 which will establish a 400kV double busbar substation connecting into ZA Route (Cockenzie-Eccles) and SPT-RI-2080 shall establish a new 132kV substation at the same site as well as a proposal to rebuild the 132kV circuit between Dunlaw Extension substation and Galashiels substation.

The existing circuit (P Route) will be rebuilt with a similar L7 steel tower type and twin UPAS conductor bundle meaning the maximum rating required for the 132kV corridor would be established between Dunlaw Extension, Gala North, Galashiels and Eccles substations. The works under SPT-RI-2079 and SPT-RI-2080 are driven by approximately 450MW of contracted generation applications into Dunlaw Ext substation and Gala North 132kV substation.

The network diagram in Figure 4 shows the configuration whereby the 132kV circuits between Galashiels and Eccles are rebuilt (under SPT-RI-151b) and the SPT-RI-2079 and SPT-RI-2080 are also completed creating the following circuits:

- 2 x Dunlaw Extension to Gala North 132kV circuits
- 1 x Gala North to Galashiels 132kV circuit
- 1 x Gala North to Eccles 132kV circuit
- 1 x Galashiels to Eccles 132kV circuit.

This configuration means that Eccles 132kV group is fully supported, as is Galashiels and Hawick with double circuit connections into each site.

Given other works in this area of the system it is therefore key that the works completed as part of the proposed project (within scope of this paper) are scoped to ensure the future configurations and connections can be accommodated.

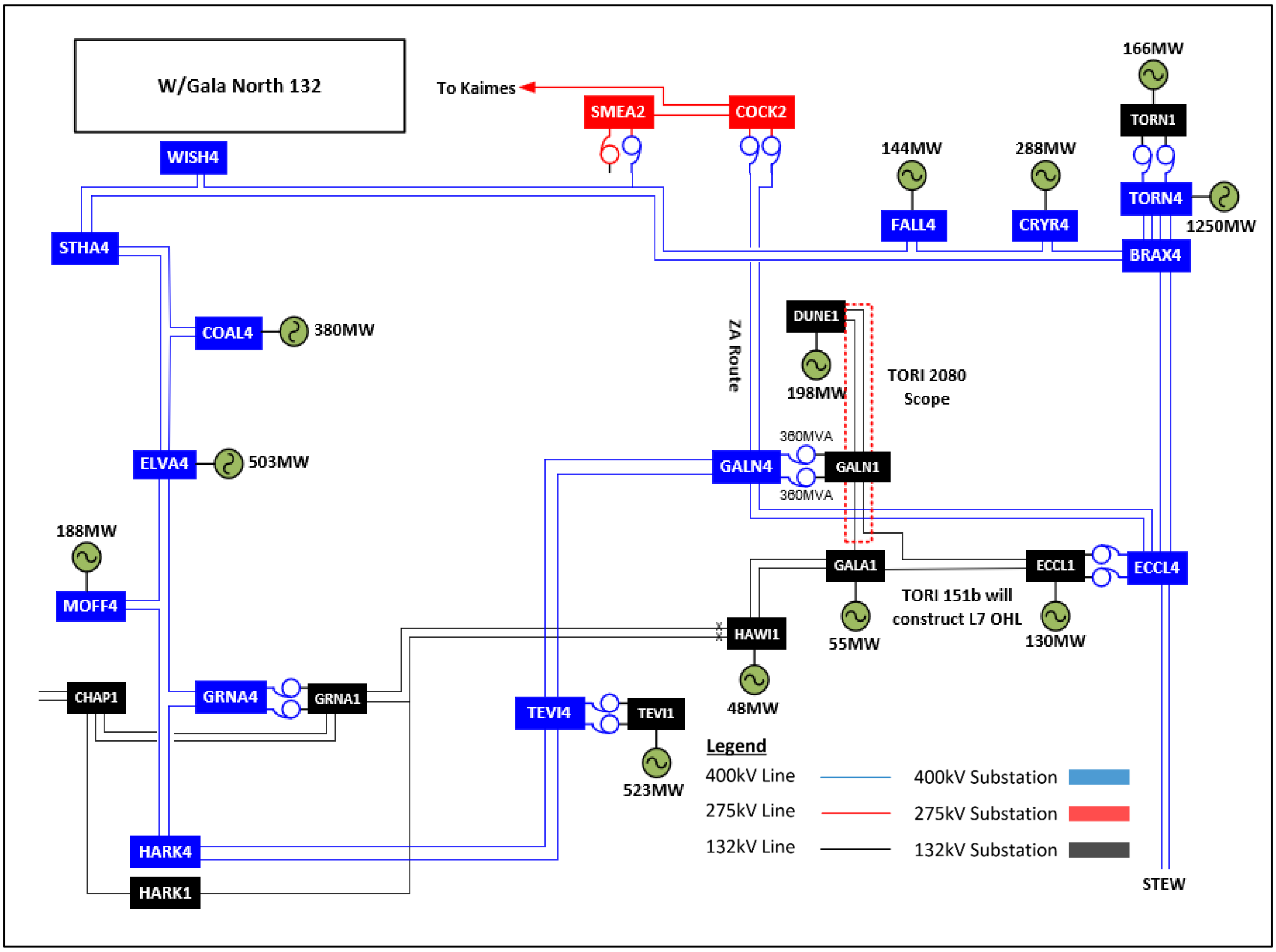


**Figure 4: Network Design Post TORIs 151b, 2079 & 2080**

Note: the above is focused on the works completed under TORIs 151b, 2079 and 2080. All other system configurations are subject to other projects not covered by this paper.

### 3.3. Asset Condition

The '132-400kV Transmission Overhead Line Asset Investment Policy[6]' document covers the model describing how overhead line component's condition is expected to change over time and its calculated technical asset life based upon a condition data approach. It also defines a common way on how condition data is interpreted, removing subjectivity, and providing a clear view on how condition ratings have been concluded. These values are subsequently input into NARM to obtain a rating for the health of the asset. These NARM ratings can be found in Table 7.

SPT conducts planned inspections to ensure assets are in a condition that are safe and reliable for ongoing operation. Both U and AT routes have been subject to annual inspections to ensure public safety and a detailed condition assessment carried out every 10 years from a helicopter to check the condition of all components that can be visually assessed.

6 OHL-01-014 '132-400kV Transmission Overhead Line Asset Investment Policy'

In addition to regular visual inspections, more detailed 'hands on' assessments have been carried out on the conductor, wood poles and steel towers on U and AT routes.

### 3.3.1. Aerial Condition Assessments

A helicopter visual inspection was undertaken by EA Technology on both U and AT route lines in 2017. Components on the tower were condition assessed against a defined specification[7].

The sections of the visual assessment report which are relevant to this EJP relate to phase fitting condition, insulator condition, earth-wire fitting condition, tower condition and pole condition. It should be noted that conductor and wood poles cannot be assessed fully by visual inspection alone and these are subject to further asset specific assessment to fully understand their condition.

#### 3.3.1.1. U Route Condition Assessment Results

A summary of the 2017 visual assessment of U route can be found in Table 3.

From the assessment it is evident that:

- with the exception of four towers, all phase fittings are graded as either CR3 or CR4;
- 80% of the phase vibration dampers are graded as CR3 or CR4;
- 75% of the earth-wire fittings are graded as CR3 or CR4; and
- all towers are recorded with failed/ineffective paintwork.

**Table 3: U Route Condition Assessment Results**

| Condition Point | | Number of towers in CR Category | | | | | |
|---|---|---|---|---|---|---|---|
| | | CR1 | CR2 | CR3 | CR4 | CR5/M | Other (U,N,W,?) |
| Muffs | | | | 20 | | 30 | 43 |
| Tower Steelwork | | | 12 | 81 | | | |
| Step Bolts | | | | 41 | | 51 | |
| Left Circuit | Insulators, Suspension | 24 | 32 | 25 | 1 | | |
| | Insulators, Tension | 2 | 7 | 1 | | | |
| | Insulator Fittings | | 4 | 42 | 46 | | |
| Right Circuit | Insulators, Suspension | | | | | | |
| | Insulators, Tension | | | | | | |
| | Insulator Fittings | | | | | | |
| Earthwire Fittings | | 7 | 17 | 34 | 35 | | |
| Vibration Dampers (Earthwire Conductor) | | 37 | 30 | 21 | 5 | | |
| Conductors | | 93 | | | | | |
| Vibration Dampers (Phase Conductors) | | 6 | 13 | 52 | 22 | | |
| Spacers | | | | | | | |
| Vegetation within Tower | | 86 | | 4 | 1 | 2 | |
| Vegetation within Span | | 83 | 8 | 1 | 1 | | |
| Fibre Optics | | | | | | | 93 |

Figure 5 and Figure 6 show broken, corroded and worn insulator sets on the U Route. Figure 7 and Figure 8 show bent tower bracing and corroded earth wire fitting respectively.

[7] As per document TRANS-03-003 'Condition Assessment Criteria for Transmission Overhead Lines'.

**Figure 5 - U052 Broken Insulator**

**Figure 6 - U010 Corroded/Worn Fittings**

**Figure 7 - U057 Bent Bracing Steelwork**

**Figure 8 - U050 Corroded/Worn Earth-wire Fitting**

## 3.4. AT Route Condition Assessment Results

A summary table of the 2017 visual assessment of AT route can be found below.

From the assessment it is evident that:

- Of the 180 sets of phase fittings assessed, 169 of them are graded as CR3/4/5
- Pole condition is not visually assessed.
- Conductor internal condition is not assessed.

**Table 4: AT Route Summary Condition Assessment Results**

| Condition Point | | Number of towers in CR Category | | | | | |
|---|---|---|---|---|---|---|---|
| | | CR1 | CR2 | CR3 | CR4 | CR5/M | Other (U,N,W,?) |
| Tower Steelwork | | 112 | 51 | 1 | 1 | | |
| Step Bolts | | 68 | | 98 | | 1 | |
| Left Circuit | Insulators, Suspension | | 1 | 3 | 4 | 2 | |
| | Insulators, Tension | | 4 | | | | |
| | Insulator Fittings | | 2 | 10 | 2 | | |
| Right Circuit | Insulators, Suspension | 10 | 91 | 23 | 11 | 2 | |
| | Insulators, Tension | 7 | 20 | 2 | | | |
| | Insulator Fittings | | 9 | 19 | 129 | 9 | |
| Earthwire Fittings | | 10 | 4 | | 1 | | 152 |
| Vibration Dampers (Earthwire Conductor) | | 7 | 3 | 4 | 1 | | 152 |
| Conductors | | 167 | | | | | |
| Vibration Dampers (Phase Conductors) | | 51 | 33 | 74 | 9 | | |
| Spacers | | | | | | | |
| Vegetation within Tower | | 153 | | 9 | 3 | 2 | |
| Vegetation within Span | | 145 | 22 | | | | |
| Fibre Optics | | | | | | | 167 |

**Full condition assessment results from AT route can be found in Appendix C.**

Figure 9 and 10 show corroded and worn insulator sets.

**Figure 9 - AT158 Severely Corroded Insulators**

**Figure 10 - AT115 Severely Worn Fittings**

### 3.4.1.1. Energyline Pole and Tower Condition Inspections

In 2019 detailed intrusive and climbing assessments were carried out on both U and AT routes by Energyline on behalf of SPT. These inspections were commissioned to inform the case for intervention on U and AT routes.

#### 3.4.1.2. AT Route Pole Inspection

Visual inspection, hammer test and prodding test was undertaken on 13 structures (26 poles). The results have been categorised on a 1-5 basis as per OHL-17-001 '*Inspection and Testing of Wood Poles'.* A summary of the results can be seen in Table 5.

**Table 5: AT Route Pole Inspection Results**

| Structure | Visual Check | Hammer Test | Prodding Test |
|---|---|---|---|
| AT011 | 3 | 4 | 2 |
| AT013 | 4 | 4 | 2 |
| AT026 | 3 | 4 | 2 |
| AT028 | 4 | 4 | 2 |
| AT047 | 3 | 4 | 2 |
| AT048 | 4 | 4 | 2 |
| AT076 | 4 | 4 | 2 |
| AT077 | 3 | 2/3 | 2 |
| AT091 | 4 | 4 | 2 |
| AT119 | 4 | 4 | 2 |
| AT121 | 3 | 4 | 2 |
| AT135 | 4 | 4 | 2 |
| AT137 | 4 | 4 | 2 |

All poles scored either 3 or 4 on the visual inspection indicating that there is either minor or major decay occurring, pole top rot or bird / third party damage. Hammer tests scored predominantly 4 which indicates a hollow sound on one segment of the pole. All poles scored a 2 on the prodding test which means no penetration.

**Figure 11 - AT028 Splitting at Base of Pole**

**Figure 12 - AT091 Splitting at Middle of Pole**

Visual inspections noted significant decay and/or splitting was noted at eight structures. All poles with the exception of AT077 gave a 'hollow sound' on the hammer test and therefore scored CR4 indicating the presence of internal decay. Figure 11 and Figure 12 show the condition of the poles.

#### 3.4.1.3. U and AT Route Tower Assessment

Seven towers on U route and eight towers on AT route were inspected as part of this assessment. These assessments and associated reports were undertaken in 2019. At this point in time, the proposed replacement conductor to meet the increased rating requirements was single AAAC UPAS. These reports considered, that with significant tower and foundation strengthening, it would be feasible to reutilise towers along U and AT route to give a design life of 40 years for a new AAAC UPAS conductor system. However, the conductor now required to meet the demand in the area is a significantly larger twin AAAC UPAS or an HTLS equivalent.

The tower condition surveys found that the supports were generally in good condition consistent with age. No steelwork was identified as grade 4 or grade 5. 25 individual sections of steelwork were identified as grade 6.

It was noted that due to the age of the structures their designs were based upon deterministic loading parameters often referred to as an 'Empirical Approach' to design. New designs adopt a probabilistic approach in accordance with BS EN 50341-1 and BS EN 50341-2-9. The report considered that significant strengthening of support steelwork and upgrades to foundations would be required to accommodate the larger conductor and achieve the required level of reliability in accordance with current codes of practice.

### 3.4.2. Conductor Measured Condition

The '132-400kV Transmission Overhead Line Asset Investment Policy' document[8] describes the model used to detail how OHL conductor condition is expected to change over time and its technical asset life. With the technical asset life based on condition data, conductor type, grease levels and environment type. Further to this it outlines a common methodology in which the data is interpreted to remove subjectivity and providing the business with a clear view of how condition ratings are concluded and how OHL assets are categorised and prioritised for replacement.

The asset management strategy for OHL focuses on optimising the replacement programme for ACSR core only greased conductors and ACSR conductors where there is evidence of fatigue. This programme has been developed using evidence collected across the network for this type of OHL conductor and the associated corrosion rates. ACSR conductor life is based on its loss in strength due to internal corrosion and/or wind induced damage. The end of life has been defined as having a 15% loss of strength. This value has been chosen as it was determined that at this level failure of the conductor can occur under high environmental loads.

The phase conductors on AT route are original to the 1959 construction. These conductors are core only greased and have exceeded their predicted lifespan. Both the phase conductor and Lynx earth-wire on U route are from 1969.

Cormon testing was carried out in 2010 on U route and 2019 on AT route. In both cases possible and partial corrosion results were noted. This is set out in Table 6..

**Table 6: Conductor Condition Assessment Results**

| Route | Span Number (i.e. span U90 to U91) | | Conductor Score | Conductor Type | None % | Possible % | Partial % | Suspect Data % | Test Date |
|---|---|---|---|---|---|---|---|---|---|
| U | 91 | AT151 | 4 | Lynx | 65.7 | 30.2 | 4.2 | | 04/10 |
| U | 90 | 91 | 4 | Lynx | 84.4 | 13.2 | 2.4 | | 04/10 |
| AT | 159 | 160 | 4 | Lynx | 32.6 | 63 | 4.2 | 0.2 | 07/19 |
| U | 90 | 91 | 4 | Lynx | 86.8 | 11.9 | 1.3 | | 07/19 |

The percentage numbers in the table relate to the thickness of zinc on the steel core. None (>20µm), possible (>12-20µm) and partial (>5-12µm). These are then transposed into NARM condition ratings.

#### 3.4.2.1. Foundations

While no intrusive foundation inspections have been undertaken on either U or AT route, it can be seen from the line schedules for U route that 25% of the foundations are a grillage type foundation.

Grillage foundations were commonly constructed as the foundation for overhead line supports during the 1920s and 1930s to avoid the need for concrete. Grillage foundations consist of buried galvanized steel members provided in single or double layers onto which the support structure

[8] OHL-01-014

steelwork is attached. The buried steel is exposed to a reactive environment which increases the risk of below-ground corrosion that can lead to foundation failure.

Empirical rules governed the design of grillages prior to modern principles of soil mechanics therefore design capacity is often unknown in respect of re-utilisation. When replacement conductor systems are being considered foundation strengthening is therefore anticipated to be necessary.

## 3.5. NARM Summary

The NARM methodology models the risk associated with the failure of certain lead assets in the network by identifying the asset condition, its probability of material failure and the consequences of the asset failure such as system, environment, safety and financial. The methodology enables the calculation of health and risk bands generated from the assets specific data (age, duty, location, function), the data collected through inspections and any other measured condition (such as common testing or conductor sampling for OHL) as described in Section 3.2.

The NARM metrics are used to provide logical links between asset data held in our Asset Management Systems and the proposed interventions and are a key element of justification of investment.

The health bands, P bands, represent the health of the asset and give an indication of the likelihood of asset failure. The P bands range from 1-10, being 1 very good health (lowest probability of failure) and 10 poor health-end of the operational life (highest probability of failure).

The risk bands, R bands, represent a measure of the risk of the asset relative to the rest of the assets of the same type and voltage. There are 10 R bands ranging from 1 to 10, R1 being lowest risk and 10 highest risk. This metric is useful to prioritise asset interventions within the same asset category (i.e. 132kV OHL conductor) as required.

The assets proposed for intervention under this project have the following risk and health bands:

**Table 7: NARM Data for AT Route**

**Fittings Health**

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | 5 | | | 31 | | 4 | | | 14 |
| U Towers | | 5 | | | 5 | 34 | 20 | | | 34 |
| AT Poles | | | | | | | 126 | | | |

**Fittings Risk**

| | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | 12 | 25 | 9 | | | | 6 | | 2 |
| U Towers | | 39 | 20 | 29 | 4 | | 1 | | | |
| AT Poles | | | 126 | | | | | | | |

**Conductor Health**

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | | 0.5029 | | 0.3566 | | 4.2726 | | 3.3725 | 3.8139 |
| U Towers | | | | | | 0.7344 | 0.4504 | 23.9773 | 0.6048 | |
| AT Poles | | 3.144 | | | | | 18.649 | | | |

**Conductor Risk**

| | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | 9.9526 | 2.3659 | | | | | | | |
| U Towers | | 25.7669 | | | | | | | | |
| AT Poles | | 3.144 | 18.649 | | | | | | | |

**Tower Health**

| | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | P9 | P10 |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | 7 | 33 | | 1 | | | | | |
| U Towers | | | | | 1 | 46 | 42 | 2 | | 2 |

**Tower Risk**

| | R1 | R2 | R3 | R4 | R5 | R6 | R7 | R8 | R9 | R10 |
|---|---|---|---|---|---|---|---|---|---|---|
| AT Towers | | 41 | | | | | | | | |
| U Towers | | 93 | | | | | | | | |

### 3.6. Asset Defects on AT Route

On the 17th of December 2023 a trip was recorded on the ECCL-GALA 2 circuit. The identified cause was mechanical failure of an insulator set at pole AT140 due to severe corrosion. This was subsequently repaired and returned to service. A survey of the route to identify critical crossings was carried out and using the spares available there was an outage taken on the 20th of December 2023 to replace insulators on the identified critical spans.

On the 5th of January 2024 a contractor reported a low hanging conductor on AT route. This was located at pole AT092. No trip had taken place meaning that there was a low hanging conductor live and in service at 132kV. The failure mechanism was the same as at AT140. The route was switched out of service for the repairs and the decision was taken to leave the route out of service until all suspension insulators could be replaced. The route as then brought back into service once the replacement works were complete. The proposed replacement insulators are polymeric rather than traditional glass sets due to the long lead times (52 weeks) on glass insulators. The low conductors and failed insulator are shown in Figure 13 and Figure 14 respectively.

Figure 13 - Low Hanging Live Conductors AT092

Figure 14 - Failed Insulator Set

## 4. Optioneering

This section provides a description of each option for U & AT routes and details the key considerations that were considered in proposing or discounting each proposal. A summary of each option is described at the end of this section, with the selected option and highlighted and an in-depth review provided.

### 4.1. Option 1: Baseline - Do Nothing / Deferral

A 'Do Nothing' option has been considered to represent the ongoing maintenance and repair as part of business-as-usual. This option involves the minimum level of intervention required to remain compliant with all relevant safety and legal regulations.

This option is economically inefficient due to the overall condition of the 132kV towers, poles and conductors being at the end of life. In addition, deferring the investment will accelerate the continual deterioration of the OHL components.

The proposed works to be completed on U & AT route were previously deferred from T2 to T3 based on the uncertainty surrounding the generation to come onto the network in the area; as previously detailed in section 2.1.3. The current condition of the existing poles on the route are such that a further deferral would not be possible.

Also, this option does not provide the capacity increase required to accommodate the contracted generation forecast to connect in the area. In this respect, this would be inconsistent with SPT's statutory duties and licence obligations[9].

9 Including Licence Conditions D3 and D4A, which require SPT to comply with the NETS SQSS and to offer to enter into an agreement with the system operator upon receipt of an application for connection, such offers being in accordance with the System Operator Transmission Owner Code (STC) and associated Construction Planning Assumptions provided by NGESO.

## 4.2. Option 2: Reconductor Existing Lines

Option 2 proposes reusing the existing structures on U & AT routes with replacement conductors. Due to design code changes, replacement of the conductor system, even on a like for like basis, will require significant tower and foundation strengthening and the replacement of all insulators and fittings and all poles on AT route. The industry accepted minimum design life for new steel towers is 80 years as defined in NGTS 2.04 '*Generic Design Principles for Overhead Lines'*. The replacement of the existing conductor system with single AAAC Poplar conductor will not provide the necessary capacity. It is considered that single ACCR 'LARK' conductor could provide additional capacity, however in both cases the new conductors would have an expected service life in excess of 40 years. When considering that the towers on U route will be approaching 100 years old at the time of reconductoring, this option cannot be recommended. The subject PL1 OHL towers have achieved long-duration operational life and have now exceeded what is currently specified as their expected design life.

## 4.3. Option 3: Rebuild Route with L4 Towers and 1 x AAAC 'UPAS' Conductor

Following on from Option 2 above which outlines that the new structures across both U & AT are required given the condition of the assets, an option has been assessed to rebuild the two single circuit routes using L4 steel towers and using a AAAC 'UPAS' conductor (single UPAS).

This conductor system gives a summer pre-fault summer rating of 176MVA. This conductor system would meet the requirement to support the Grid Supply Points at Galashiels and Eccles as well as the existing generation connections. However, the future developments proposed in this area of the system[10] - which involves reinforcement using L7 towers with a 2 x AAAC 'UPAS' conductor system (twin UPAS) – would leave the circuits between Galashiels and Eccles being the thermal 'bottleneck' across this corridor.

The costs associated with this option is £56.01m and this is inclusive of, but not limited to, the following items:

- Construction of 29.7km of new L4 OHL towers.
- Installation of 29.7 route km of AAAC 'UPAS' conductor
- Installation of 2 x 1.2km of 132kV cable sections into Galashiels substation rated in line with UPAS conductor system (currently assumed to be 1200mm$^2$ AL XLPE cable ahead of detailed design)[11]
- Dismantling and removal of existing U & AT Route towers/conductor

Progressing with this option would significantly limit the capacity of the 132kV corridor between Dunlaw Ext, Gala North, Galashiels and Eccles following the completion of SPT-RI-2080. This would not allow SPT to meet its contracted obligations to connect customers in the area given the lower capacity and as a result this has been discounted.

10 The SPT 'P Route' between Smeaton, Dunlaw Ext and Galashiels substations – contracted to be rebuilt under SPT-RI-2080 (Ref. Section 3.2).

11 This point is consistent across all options which have been evaluated as it is not feasible to construct new OHL entries into Galashiels substation given the expansion of housing in the area and other associated challenges.

## 4.4. Option 4: Rebuild Route with L4 Towers and 1 x HTLS 'LARK' Conductor

Similar to Option 3 outlined above this option considers the construction of new L4 towers between Galashiels and Eccles substations but instead of using AAAC 'UPAS' conductor this option proposes using a High Temperature Low Sag (HTLS) conductor to provide a higher overall rating. The conductor system specified is an ACCR 'LARK' conductor which has a summer pre-fault rating of 227MVA.

Whilst this conductor rating would meet the existing network need it would still fall short of the proposed rating under the SPT-RI-2080 scheme and therefore still present a thermal 'bottleneck' on the system between Galashiels and Eccles.

The cost associated with this option is £66.08m and this is inclusive of, but not limited to:

- Construction of 29.7km of new L4 OHL towers.
- Installation of 29.7 route km of ACCR HTLS 'LARK' conductor
- Installation of 2 x 1.2km of 132kV cable sections into Galashiels substation rated in line with LARK conductor system (currently assumed to be 2000mm$^2$ AL XLPE cable ahead of detailed design)
- Dismantling and removal of existing U & AT Route towers/conductor

When comparing the costs of Option 3 versus Option 4 it can be seen that the use of HTLS conductor significantly increases the cost of the project whilst only providing a modest uplift in capacity of 51MVA per circuit / 102MVA overall. As stated above progressing with this option would limit the capacity of the 132kV corridor between Dunlaw Ext, Gala North, Galashiels and Eccles following the completion of SPT-RI-2080 and as a result this has been discounted.

## 4.5. Option 5: Rebuild Route with L7 Towers and 1 x AAAC 'UPAS' Conductor

Option 5 proposes to construct new L7 towers between Galashiels and Eccles substations and use a 1 x AAAC 'UPAS' Conductor (single UPAS) system. This option has been included to outline the cost difference between the L4 and L7 towers suites.

Similar to Option 3 this conductor system would meet the requirement to support the Grid Supply Points at Galashiels and Eccles as well as the existing generation connections however given the future developments proposed in this area under SPT-RI-2080 the selection of conductor system would limit the overall power transfer capability of the 132kV corridor.

The costs associated with this option is £63.47m and this is inclusive of, but not limited to:

- Construction of 29.7km of new L7 OHL towers.
- Installation of 29.7 route km of 1 x AAAC "UPAS" conductor (single UPAS)
- Installation of 2 x 1.2km of 132kV cable sections into Galashiels substation rated in line with UPAS conductor system (currently assumed to be 1200mm2 AL XLPE cable ahead of detailed design)
- Dismantling and removal of existing U & AT Route towers/conductor

Due to the installation of the same tower types that are proposed under SPT-RI-2080 this option helps to create a pathway to ultimately having a 132kV power corridor which is rated as high as possible however the installation of the single UPAS phase conductor would still limit the capacity of the corridor. Options have been explored by SPT whereby the installation of a single phase conductor could be made as part of a first stage of works and a second phase conductor added in line with the SPT-RI-2080 project however the stringing of a second phase conductor offers many challenges such as having no original pulling bond to use for the new conductor being installed as well as the 'new' and 'existing' conductor systems having different tensions which would make ongoing asset operation challenging to manage.

### 4.6. Option 6: Rebuild Route with L7 Towers and 2 x AAAC 'UPAS' Conductor

Building on Option 5, this option proposes to construct new L7 towers between Galashiels and Eccles substations and use a 2 x AAAC "UPAS" Conductor system (twin UPAS). This would match in with the specification of the tower suite and conductor system under SPT-RI-2080 and provides the maximum rating required for the 132kV corridor across this part of the system.

The costs associated with this option is £66.26m and this is inclusive of, but not limited to:

- Construction of 29.7km of new L7 OHL towers.
- Installation of 29.7 route km of 2 x AAAC "UPAS" conductor (twin UPAS)
- Installation of 2 x 1.2km of 132kV cable sections into Galashiels substation. These cable circuits will be lower than the OHL conductor rating and this is due to spatial constraints into Galashiels which prevent SPT from installing multiple cables per phase, see Section 3.8.1 for more detail (the cable circuits are assumed to be 2000mm$^2$ Cu XLPE cable ahead of detailed design).
- Dismantling and removal of existing U & AT Route towers/conductor

Comparing Options 5 and 6 shows that the installation of a second phase conductor represents a circa £2.5m increase in total project costs however provides a much higher overall capacity, an additional 134MVA, of the corridor between Galashiels and Eccles substations. This additional capacity will be required to enable the connection of 585MW as referenced in Table 2

Likewise comparing Option 4 to Option 6 shows a very similar cost when comparing the establishing of a L4 tower route with HTLS 'LARK' conductor (£66.08m) and a L7 tower route with twin UPAS corridor (£66.26m).

Figure 15 shows the proposed configuration post the completion of SPT-RI-151b with the double circuit from Galashiels to Eccles.

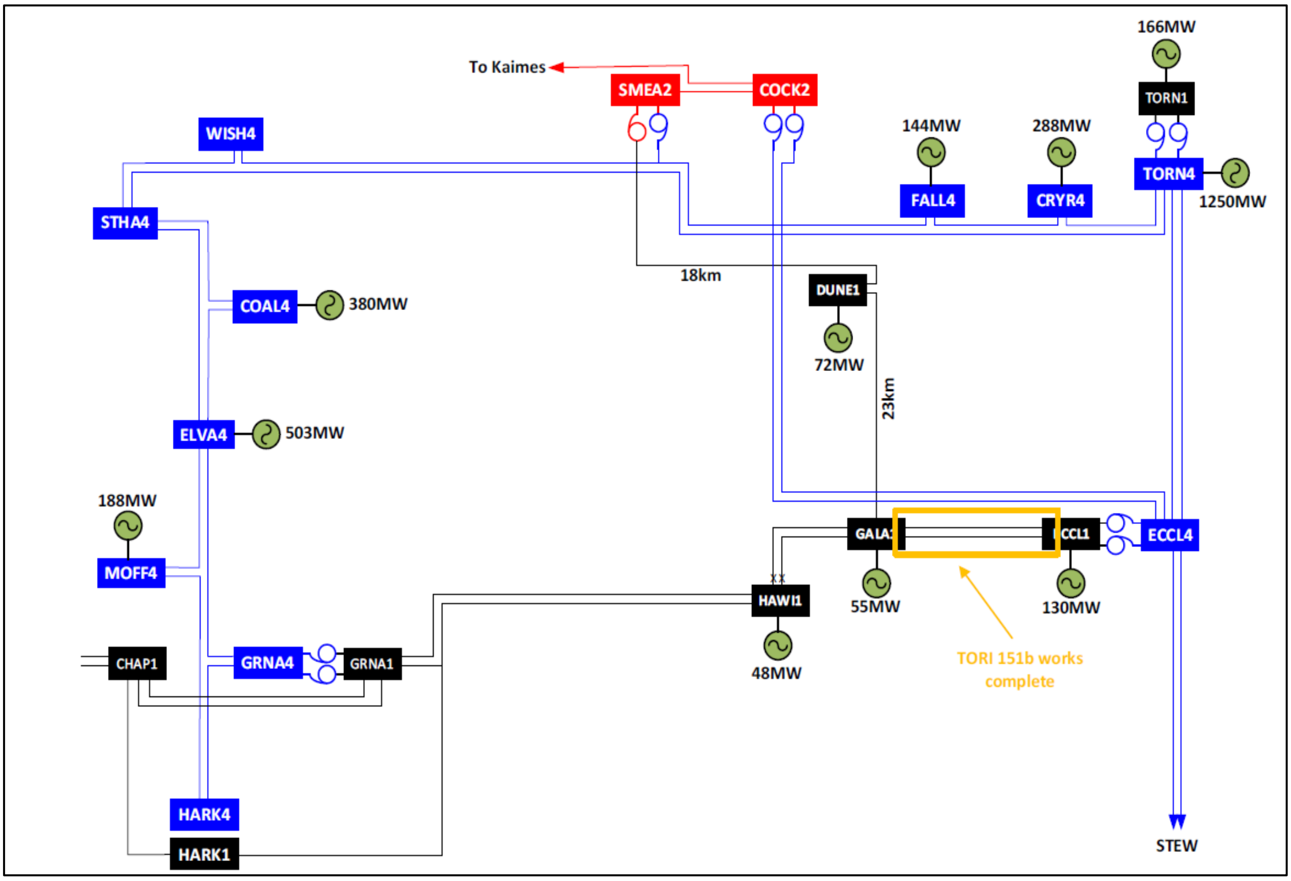


Figure 15 – Proposed Final Configuration Post SPT-RI-151b

## 4.7. Option 7: Full Underground Cable Route

The possibility of creating a full underground cable route between Galashiels and Eccles 132kV substations has been explored. This would create a full 31km route between the two substations, avoiding the need to rebuild the existing overhead line routes and remove the structures entirely. This option however has been discounted as the cost associated with these works is £150.62m which is over twice the cost of the proposed option under Option 6.

**Table 8: Options Narrative**

| Options | Map | Layout of Substation/ Connection | Layout of all Route Works | Relevant Survey Works | Narrative Consenting Risks | Narrative Preferred Option | Narrative Rejection |
|---|---|---|---|---|---|---|---|
| **Rejected – Option 1 (Baseline):** Do Minimum / Deferral | | N/A | N/A | N/A | N/A | N/A | This option does not meet the main objectives of the project due to the overall condition of the 132kV OHL assets approaching end of life and no intervention will add considerable risk to SPT's Network. This option is also inconsistent with SPT's various statutory duties and license obligations. |
| **Rejected – Option 2:** Reconductor Existing Lines | | N/A | N/A | N/A | N/A | N/A | This option leaves the existing towers which have been shown to be approaching their end of life, in service, adding considerable risk to SPT's network. |
| **Rejected – Option 3:** Reduced Capacity OHL Rebuild Route with L4 Towers and 1 x AAAC "UPAS" Conductor | | N/A | N/A | N/A | Early engagement with landowners, environmental bodies and employing low bearing pressure ground vehicles and trackway where possible to minimise extents of stone tracks | N/A | The reduced capacity solution using L4 Towers with single UPAS conductor system is lower cost than the proposed twin UPAS solution, however the reduced circuit capacity of 176MVA does not meet the required capacity to accommodate the contracted generation or future reinforcements.<br><br>The cost associated with this option is £56.01m. |
| **Rejected – Option 4:** Rebuild Route with L4 Towers and 1 x HTLS "LARK" Conductor | | N/A | N/A | N/A | Early engagement with landowners, environmental bodies and employing low bearing pressure | N/A | The cost of this solution, £66.08m (23/24) is comparative to that of the proposed twin UPAS OHL, £66.26m (23/24), however the 227MVA capacity of the circuit is lower than the calculated required capacity to |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | | ground vehicles and trackway where possible to minimise extents of stone tracks | | accommodate the connection of the contracted generation or future reinforcements. |
| **Rejected Option 5:** Rebuild Route with L7 Towers and 1 x AAAC "UPAS" Conductor | | N/A | N/A | N/A | Early engagement with landowners, environmental bodies and employing low bearing pressure ground vehicles and trackway where possible to minimise extents of stone tracks | N/A | The L7 tower suite is in line with the proposed SPT-RI-2080 scope of works however the single UPAS conductor system provides a lower circuit capacity and does not meet the required capacity to accommodate the contracted generation or future reinforcements.<br><br>The cost associated with this option is £63.47m. |
| **Preferred – Option 6:** Rebuild Route with L7 Towers and 2 x AAAC 'UPAS' Conductor | | N/A | N/A | N/A | Early engagement with landowners, environmental bodies and employing low bearing pressure ground vehicles and trackway where possible to minimise extents of stone tracks | Seven options have been reviewed in terms of scope feasibility, cost, timescales and construction risks with Option 6 demonstrating the primary objective of lead assets replacement and accommodation of new generation in the area. | This is the proposed option for the project and offers the highest transfer capacity between Galashiels and Eccles substations as well as matches in with the proposals under SPT-RI-2080 and would create a higher capacity 132kV corridor in this part of the system.<br><br>The costs associated with this option is £66.26m. |
| **Rejected – Option 7:** Underground Cable Route | | N/A | N/A | N/A | N/A | N/A | This option proposes the installation of a new 132kV double circuit cable route between Galashiels and Eccles substations. The costs associated with this solution is £150.62m and is over twice the cost associated with the proposed Option 6. |

### 4.8. Selected Option: Option 6: Rebuild Route with L7 Towers and 2 x AAAC "UPAS" Conductor

Option 6 is considered to be the most economically viable option given the objectives of this project. This option achieves the main objective of addressing the condition issues relating to U and AT overhead line routes' assets as well as provides the necessary capacity to accommodate the connection of new generation in the area.

It enables the further reinforcement works to the network in the area under SPT-RI-2080 and will ensure SPT is developing an economic, coordinated and efficient system.

The works proposed in this paper are scheduled to begin in 2027, with an energisation date for the new circuit being scheduled for September 2028. The works to demolish the U & AT routes will begin upon the de-energisation of the circuits and will be completed in 2029, completing the scope of the works within the RIIO-T3 period.

Figure 16 shows the single line diagram between Galashiels and Eccles substations with the main difference from the current configuration being the cable sections out of Galashiels to replace the overhead line sections that are currently in service. Figure 17 shows the proposed overhead line route for the TORI 151b rebuild.[redacted].

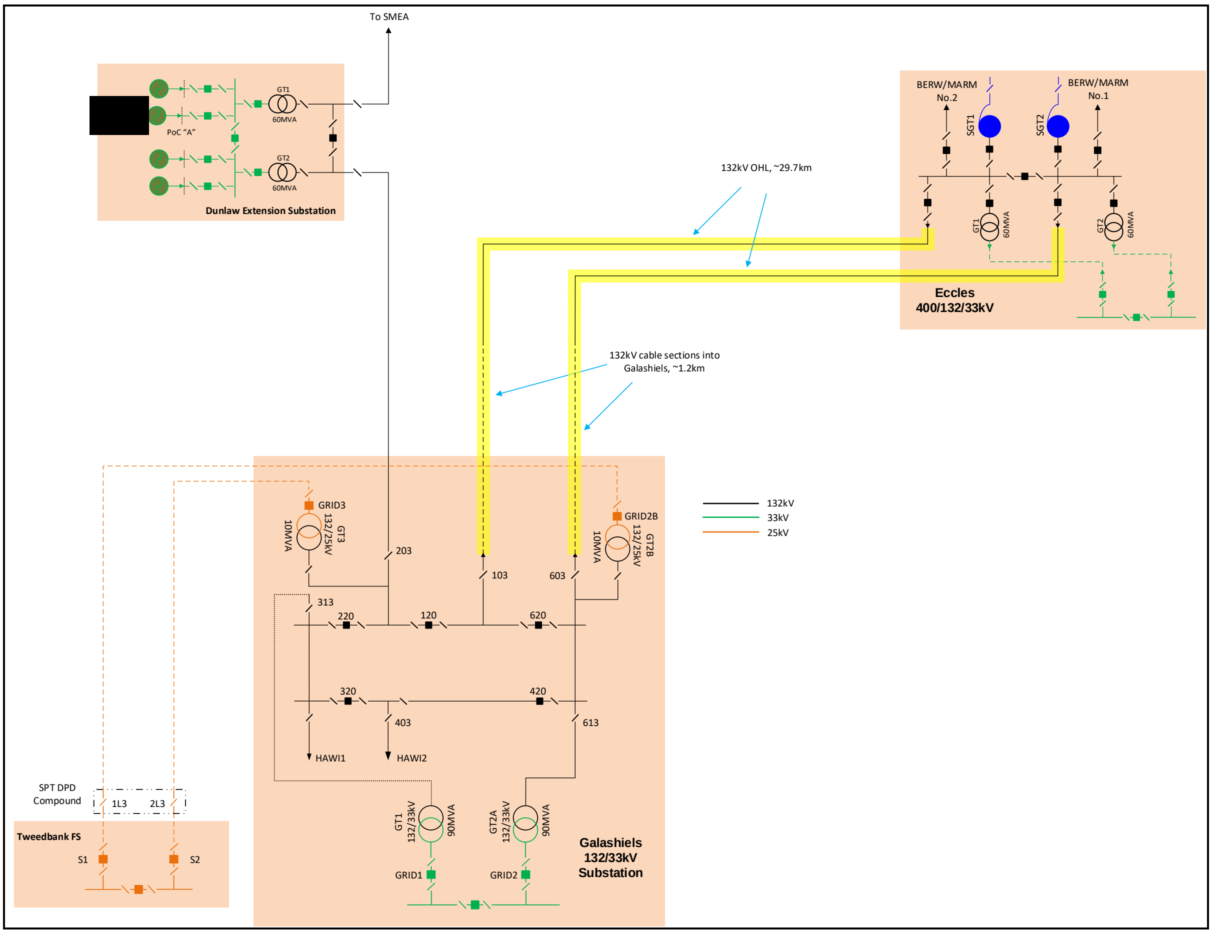


**Figure 16 - System Single Line Diagram between Galashiels and Eccles 132kV Substations**

[redacted]

**Figure 17 – Proposed Route**

### 3.8.1 Galashiels 132kV Cable Section

At present the circuits from Dunlaw Extension and Eccles (P, U and AT Route) all come into Galashiels via overhead lines which is shown in Figure 18.

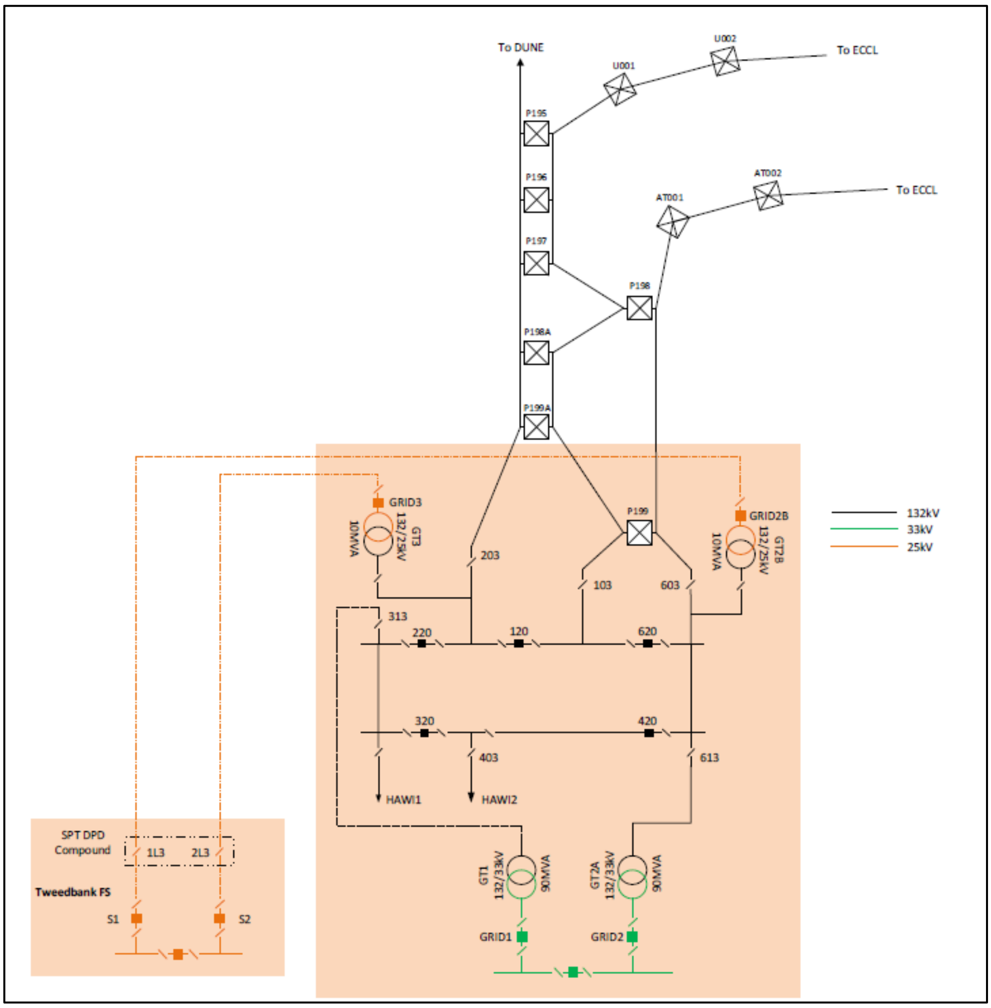


**Figure 18 - Galashiels 132kV Substation**

Ideally all three connections would remain into Galashiels or given that the single circuit P Route (Smeaton-Dunlaw Ext-Galashiels) is proposed to be rebuilt with a double circuit route that all circuits could be terminated into Galashiels. However, Galashiels 132kV substation is unable to accommodate any further circuit terminations without triggering the rebuild of Galashiels substation itself.

When developing the solutions to rebuild U and AT Routes it was identified that SPT's ability to terminate the circuits into Galashiels via overhead lines was not possible due to the challenges associated with routing new circuits in locally around Galashiels substation. As such it is proposed to terminate the overhead line circuit north of Galashiels substation and route new cable circuits into the substation.

The space in the proposed roadway is limited therefore it is proposed to install a single core per circuit with the highest available rating which is a 2000mm$^2$ Cu XLPE cable. A 2000mm$^2$ Cu XLPE cable will give approximately 282.8MVA compared with the 352MVA rating of the twin UPAS conductor. This proposed cable will give the closest comparative rating compared to the conductor for the lowest possible cost. This will mean that ahead of the completion of the SPT-RI-2080 works the Galashiels to Eccles circuits will have a summer pre-fault rating of 282.8MVA.

Given the configuration that is proposed and shown Figure 19 to complete the proposed works prior to the SPT-RI-2080 works, it is proposed to install an L7 DJT terminal tower with cable baskets and a third cross-arm. The cable baskets shall connect to the 2000mm$^2$ Cu XLPE cable circuits and allow for the Galashiels to Eccles circuits be connected here.

Figure 19 shows this new L7 DJT terminal to be installed and notes the works to be removed under the scope of TORI 151b namely the decommissioning of U Route towers and AT Route towers. It should be noted that during this time P Route will stay in operation with the associated P Route towers (P195, P196, P197, P198A and P199) remaining as the connection to Dunlaw Extension shall still be in operation. As part of the U and AT Route decommissioning tower P198 can be removed.

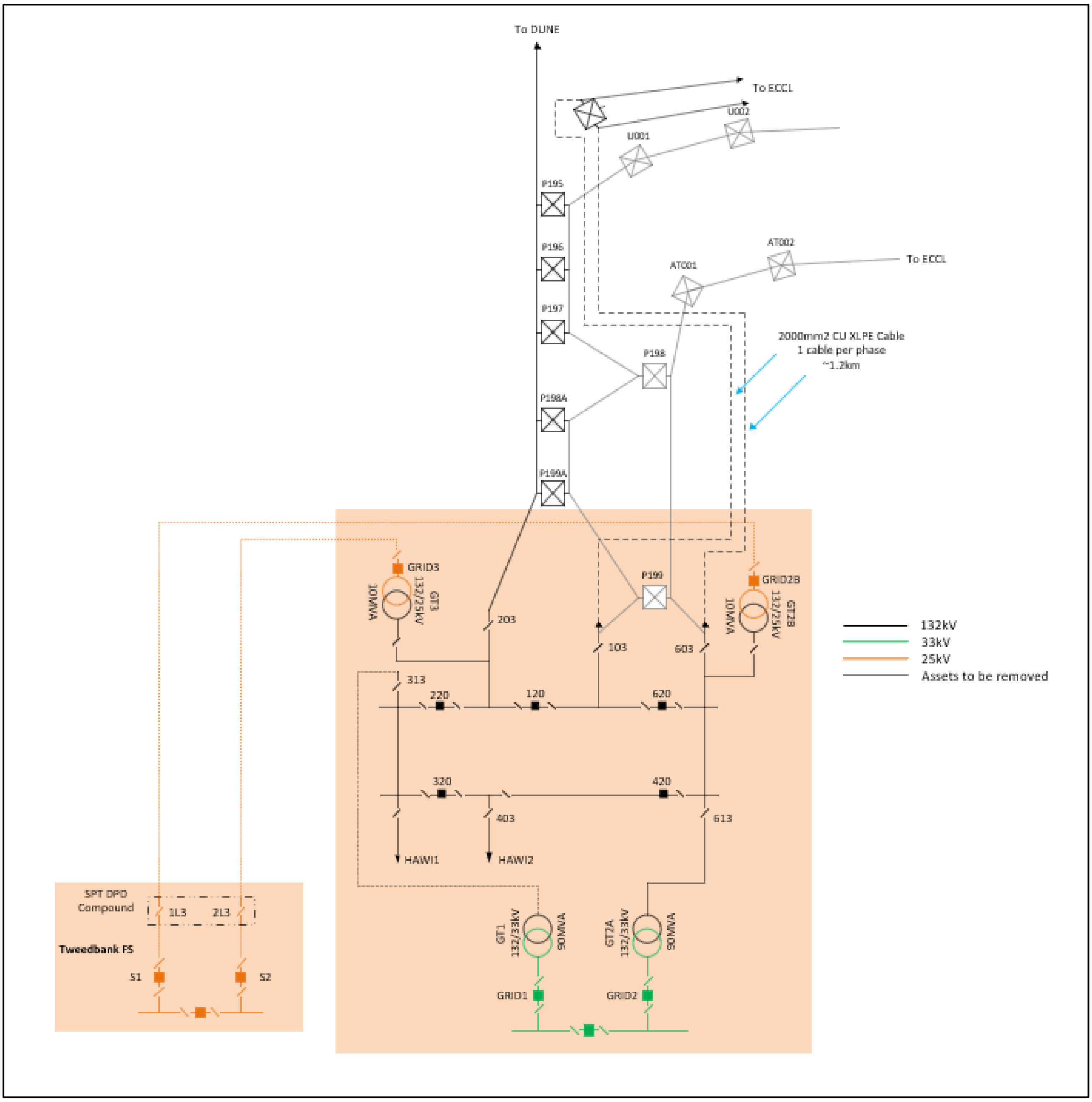


**Figure 19 - Galashiels 132kV Works as part of TORI-151b**

Figure 20Figure 20 shows the indicative new terminal tower to be installed to the north of Galashiels substation where the new Eccles circuit will terminate. This shows the new Galashiels to Eccles No.1 circuit being the most northerly and the Galashiels to Eccles No.2 circuit on the south.

[redacted]

**Figure 20 - Galashiels Terminal Tower Location**

### 4.9. Whole System Outcomes

It should be noted that our optioneering approach has identified 'Whole System' interactions with other electricity network / system operators (i.e., SP Distribution) in the development of our proposed solution and has considered the appropriate 'Whole System' outcome. This is with consideration that the proposed solution in this EJP, by enabling connection of new renewable generation to the SPT network, reduces the potential congestion volume over the SP Distribution (SPD) network as the DNO responsible in the area, and has been designed with SPD's requirement for a future GSP in the area.

## 5. Project Cost

The preferred option to provide the most economic and efficient solution to meet both the non-load and load requirements of the assets is the solution outlined in Section 3.6 and noted as Option 6. Option 6 considers the full replacement of U & AT routes with L7 132kV towers with twin UPAS conductor system to create a new 132kV route between Galashiels and Eccles (to be known as DW Route).

To ensure that the project is delivered in a timely manner to facilitate the connection of contracted generation in the area, a staged approach to the project has been applied. Construction of the new DW route will be completed, in parallel with the existing U route, with connections into both Galashiels and Eccles established via a cable routes. The new route will then be energised, in 2028, before the existing U & AT routes are decommissioned and dismantled to complete the works set out in this proposal.

As previously noted, there are two 132kV rebuild projects in this area of the SPT system and consideration for both needs to be considered. The proposed 'day one' configuration for the Galashiels to Eccles 132kV circuits is not dissimilar to the configuration on the system today however it will enable SPT to migrate to a different configuration in line with the SPT-RI-2080 works.

The works for SPT-RI-151b are as follows:

Galashiels 132kV Substation

- Install 2 x 1.2km 132kV cable circuits (1 cable per phase) to establish connection between Galashiels 132kV bays and the L7 terminal tower.
- De-energise the U & AT route overhead line circuits.
- All control and protection works.
- All environmental and civil works.

Eccles 132kV Substation

- Install overhead line gantries to terminate the incoming 132kV circuits.
- All control and protection works.
- All Environmental and Civil works.

Galashiels to Eccles Overhead Line Works (DW Route)

- Construct a new 29.7km 132kV double circuit overhead tower line, using L7 towers and twin UPAS conductor, between Galashiels 132kV and Eccles 132kV substations.
- Remove existing U & AT route towers and conductor system between Galashiels 132kV and Eccles 132kV substations.
- All control and protection works.
- All Environmental and Civil works.

The thermal ratings for twin conductor 300mm$^2$ AAAC (UPAS) EHC system thermal ratings* at 75ºC operating temperature are set out in Table 9.

**Table 9: Proposed conductor ratings**

| Season / State | Amps | MVA |
|---|---|---|
| **Winter Pre Fault** | 1770 | 406 |
| **Winter Post Fault** | 2120 | 482 |
| **Spring/Autumn Pre Fault** | 1690 | 386 |
| **Spring/Autumn Post Fault** | 2000 | 460 |
| **Summer Pre Fault** | 1540 | 352 |
| **Summer Post Fault** | 1830 | 420 |

**At 75C Maximum Operation Temperature at 132kV.*

## 5.1. Estimated Total Project Cost

A Business Plan estimated cost of the project is indicated in Table 10.

**Table 10: Project Cost Estimate (direct, 2023/24)**

| | | |
|---|---|---|
| [redacted] | | |
| Total | | **66.26** |

Expenditure incidence is summarised in Table 11.

**Table 11: Expenditure Profile**

| **Estimated Direct CAPEX value per year, £m, 23/24 price base** |
|---|

| Delivery Year | Pre-RIIO-T2 Total Direct CAPEX | Yr. 2022: Direct CAPEX | Yr. 2023: Direct CAPEX | Yr. 2024: Direct CAPEX | Yr. 2025: Direct CAPEX | Yr. 2026: Direct CAPEX | **RIIO-T2 Total: Direct CAPEX** | Yr. 2027: Direct CAPEX | Yr. 2028: Direct CAPEX | Yr. 2029: Direct CAPEX | Yr. 2030: Direct CAPEX | **RIIO-T3 Total: Direct CAPEX** | **Total: Direct CAPEX** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2030 | 0.06 | 0.06 | 0.09 | 0.72 | 0.37 | 0.42 | 1.66 | 14.82 | 25.85 | 22.98 | 0.95 | 64.60 | 66.26 |

## 5.2. Regulatory Outputs

The indicative primary asset outputs are identified in Table 12

**Table 12: Regulatory Outputs**

| Asset Categories | Asset-Sub Category | Asset Voltage/Rating | Intervention | Addition | Disposal |
|---|---|---|---|---|---|
| Overhead Tower Line | 132kV OHL (Tower Line) Conductor Rating <352MVA | Rating >300MVA & <=400MVA | Addition | 59.4 km | |
| Overhead Tower Line | 132kV OHL (Tower Line) Conductor Rating < 89MVA | Rating <300MVA | Disposals | - | 40.38km |
| Overhead Line Fittings | Fittings | 132kV | Additions | 148 | |
| Overhead Line Fittings | Fittings | 132kV | Disposal | - | 168 |
| Overhead Tower Line | Tower | 132kV | Additions | 124 | |
| Overhead Tower Line | Tower | 132kV | Disposal | - | 134 |
| Cable | Circuit Cable – 1 core per phase | 132kV | Additions | 2.4km | - |
| Overhead Pole Line | Pole | 132kV | Disposals | - | 126 |
| Overhead Pole Line | OHL (Pole Line) Conductor | 132kV | Disposals | - | 21.62km |

## 5.3. Environmental and Consent Works

To install and operate the new 132kV OHL circuit, Section 37 consent is required from the Scottish Government (Energy Consents Unit). The Section 37 application for this project is currently expected to be submitted in January 2025.

The Section 37 application to the Energy Consents Unit will be accompanied by an Environmental Impact Assessment Report (EIA Report). The information contained in the EIA Report will fulfil the requirements of the EIA Regulations and will enable Scottish Ministers as the decision-making authority, to make their decisions on the application for Section 37 consent and deemed planning permission.

The EIA report will detail the findings for the assessment of the likely significant effects of the proposals on the environment in terms of its construction and operation. The assessment forms part of the wider process of EIA, which is undertaken to ensure that the likely significant effects, both positive and negative, of certain types of development are considered in full by the decision maker prior to the determination of an application for Section 37 consent and for deemed planning permission.

The main strategy for minimising adverse environmental effects of the proposals will be through careful OHL routeing. Whilst this will avoid some environmental effects other effects are best mitigated through local deviations of the route, the refining of tower locations and appropriate construction practices.

Additionally, in certain places, specific additional mitigation measures will be required, which have been undertaken through the EIA process.

Consultation will take place with Statutory Stakeholders including SEPA and Nature Scot in relation to the proposals as well as all other relevant stakeholders including the wider public and landowners.

## 6. Deliverability

SPT project management approach has been applied to this project to ensure that this work is delivered safely, and in line with the agreed time, cost and quality commitments. SPT has a proven track record of delivering essential transmission network upgrade projects and will draw upon this knowledge and experience to effectively manage these works. We work closely with our supply chain partners and this relationship is critical to the successful delivery of our plans. Our supply chain provides the support and agility to respond to changes in workload over the course of a price review. Further information Is contained within our Workforce & Supply Chain Resilience Annex. A dedicated Project Manager has been assigned to the works at every stage who is responsible for overall delivery of the scope and is the primary point of contact for all stakeholders. The project manager responsibilities include but are not limited to:

- Handing over the project from development phase and ensuring minimum requirements of the SPT project handover are met.
- System and customer updates to reflect transfer of ownership.
- Leading tender activities during development phase.
- Provision of a comprehensive resource plan to encompass all contractor and SPT operational activities.
- Booking outages and risks of trip with operational planning.
- Ensure all offline works are completed prior to any outage being taken to reduce system risk.
- Co-ordinate all site commissioning issues.
- Chair commissioning panel meetings.
- Chair progress meetings.
- Maintain the site quality plans.

Some further responsibilities of the project manager are discussed in the following sub-sections.

## 6.1. Delivery Schedule (Level 1 Programme)

A standard approach has been applied to the planning phase of these works and that will continue for the reporting and the application of processes and controls throughout the lifecycle. Table 13 summarises the key milestones within the delivery schedule. Complete detail on the energisation dates and delivery schedules for the proposed scheme can be found in Appendix B.

**Table 13: High Level Project Milestones**

| Item | Project Milestone | Estimated Completion Date |
|---|---|---|
| 1 | Technical Approval | 2023 |
| 2 | ITT Documents | 2025 |
| 3 | Tender Process | 2025 |
| 4 | Section 37 Application | 2025 |
| 5 | Final Financial Authorisation | 2026 |
| 6 | Commence Site Works | 2026 |
| 7 | Complete Site Works | 2028 |
| 8 | Dismantling of existing Routes | 2029 |
| 9 | Estimated Project Close Out | 2029 |

SP Energy Networks (SPEN) for its procurement process follows a generic global process (INS 00.08.04) for supplier pre-qualification, product technical assessment, manufacturing factory capability assessment and quality audit. The SPEN's equipment approval procedure is to:

- Identify and select candidate equipment.
- Ensuring the candidate equipment is assessed to meet the specific requirements of SPEN.
- Ensuring a structured and consistent approach is adopted for the approval of candidate equipment prior to energisation.
- Ensuring no equipment is installed on SPEN's network without first having been examined in accordance with the procedure and issued a formal internal approval.

ASSET-02-002 specifies the SPEN's approval process inclusive of assessment scope and business processes for various equipment.

Regular meetings with the Project and Construction Management Teams shall be undertaken to assess the ongoing effectiveness of the Project Management interfaces.

The Project Manager will facilitate internal Project Team Meetings, in which project progress and deliverables will be reviewed and any arising risks or issues will be discussed and addressed.

## 6.2. Risk and Mitigation

A risk register is generated collaboratively during the initial design stages to identify any risks, which if realised, could result in deviation from the delivery plan. Mitigation strategies will be developed to manage the risks identified and these will be implemented by the Project Manager. The risk register shall remain a live document and will be updated regularly. Currently, the top scheme risks have been identified as follows:

- Landfill site at Galashiels end needs to be fully surveyed for the location of the first tower so that there is no disruption to the existing land fill layers.
- Condition of the existing circuit mitigation by regular inspection.
- Working over existing distribution overhead lines to be addressed by diverting or undergrounding on a temporary basis.
- Railway and road crossings to be mitigated through scaffolding and traffic management systems or deployment of a catenary support system.
- Utilities within working areas to be addressed through procurement of records for duration of the project.
- Access routes to be addressed through early engagement with landowners, employing low bearing pressure ground vehicles and trackway where possible to minimise extents of stone tracks.

## 6.3. Quality Management

SPT adopts a ‘life cycle’ approach to Quality Management in major project delivery. Our Management Systems are certified to ISO 9001, ISO 14001 and ISO 45001. Various areas applicable to these standards ensure a quality product is delivered. The significant areas detailed below:

## 6.4. Quality Requirements During Project Development

Any risk or opportunity that may affect the quality of the product are detailed in the Project Risk Register.

The suppliers of main equipment may also receive a Factory Acceptance Test Inspection when the asset is being built.

## 6.5. Quality Requirements in Tenders

Each contract that SPT issues has a standard format. Specifically in relation to quality, this will include a Contractors’ Quality Performance Requirement (CQPR). This CQPR represents a specification that details roles and responsibilities for all parties during the works, frequency and format of reporting. It will also specify the document management process to be adhered to during the delivery of the project. In addition to the CQPR, each project has a contract specific Quality Management Plan, detailing the inspection and testing regime for works as well as the records to be maintained.

## 6.6. Monitoring and Measuring During Project Delivery

SPT Projects undertake regular inspections on projects and contractors to monitor and measure compliance with SPT Environmental, Quality and Health and Safety requirements, as detailed in the contract specifications for the work. All inspections are visual, with the person undertaking the inspection ensuring that evidence of the inspection and any actions raised are documented.

The following inspections are undertaken routinely during project delivery:

- Quality Inspections (monthly)
- Environmental Inspections (monthly, with weekly review by third party Environmental Clerk of Works)
- Safety Assessments & Contractor Safety Inspection (daily, with full time Site Manager)
- Project Management Tours (monthly).

The scope of audits and Inspections aims to determine compliance with the following:

- Procedures & Guides
- Planned arrangements for ISO 9001, 14001 & 18001
- Legal and other requirements.

## 6.7. Post Energisation

SPT Projects and SPT Operations, internal to SPEN, carry out a Defect Liability Period Inspection within the Contract Defect Liability Period with the aim of identifying any defects and rectifying them with the contractors.

## 6.8. Environmental and Wayleave Considerations

## 6.9. Environmental Planning

The following environmental surveys will require to be carried out prior to any work commencing on site:

- Ecology: Phase 1 habitat survey
- Ecology: Protected species survey
- Archaeology: Desktop based survey
- Archaeology: Field evaluation
- Archaeology: Watching brief for any ground-breaking works within identified areas[12]

The intention should be to use low bearing pressure vehicles where possible. Access routes and formation may be supplementary to existing roads and tracks and should use sustainable materials which can be reutilised where possible. Any compaction of ground should be rectified.

It is anticipated that surveys on the new route (DW Route) will identify sites of historical interest and environmental value that will require dialogue with the relevant statutory organisations before work will commence.

[12] May only be required if any proposed ground-breaking works encroach on areas of interest.

## 6.10. Wayleave Issues

The new DW route requires Section 37 consent to operate at 132kV. Any clearance infringement mitigation works, temporary access and working areas required to facilitate physical OHL works will require planning permission from the local planning authority.

Landowner agreements will be required to deliver these works. SPT will take a co-ordinated approach to all aspects of these works in view of the need to deliver an overall and integrated solution which recognises potential interaction and cumulative impacts.

## 6.11. Environmental Sustainability

IMS-01-001 encompasses all activities undertaken within and in support of SP Energy Networks three Licences. This includes operational and business support functions concerned with management of SP Transmission, SP Distribution and associated regulatory and commercial interfaces, products, services and their associated environmental, social and economic impacts. The policy makes the following commitments which shall be respected in any works associated with this scheme.

SP Energy Networks will incorporate environmental, social and economic issues into its business decision-making processes, ensuring compliance with or improvement upon legislative, industry, regulatory and other compliance obligations. SPT will deliver this by being innovative and demonstrating leadership on the issues which it recognises as being important to the SPT business and its stakeholders. This includes a commitment to the following:

- Ensure the reliability and availability of the Transmission and Distribution network whilst creating value and delivering competitiveness by increasing efficiency and minimising losses.
- Reduce greenhouse gas emissions in line with the Net Zero Science Based GHG target, which is a target of 90% reduction in GHG emissions by 2035 (TBC) from a 2018/19 baseline.
- Integrate climate change adaptation requirements into the asset management and operations processes to support business resilience and reduce the length and time of service interruptions.
- Consider whole life cycle impacts to reduce use of resources to sustainable levels, improve the efficiency of the business's use of energy and water and aim for zero waste.
- Improve land, air and watercourse quality by preventing pollution and contamination and protecting and enhancing biodiversity in network areas.
- Improve the service provided to local communities, supporting their economic and social development, protecting vulnerable customers, and respecting human rights.

ENV-04-014 gives specific guidance on the management of incidents with environmental consequence, or potential for environmental consequences, over and above the general requirements for the management of incidents.

The proposed design solution is also resilient to future climate change risks, such as substation flooding or potential faults from vegetation along the route.

In SPEN to reduce the number of vegetation related OHL faults, the route will be surveyed, consented, and cut on a per kilometre basis. The cutting specification entails:

- Falling distance plus 5m (i.e., Vicinity Zone) to the conductor and maintain 5 years clear from that distance.

- Clearance as 5.3m to be achieved from conductor positioned at 45° blowout and maximum sag condition. Maintain 5 years clear from that distance.

- All vegetation directly below the OHL with the potential to breach the Vicinity Zone before the next cut cycle shall be removed.

- Hedgerows shall be maintained. Species identified with no threat to breach the Vicinity Zone at any point in the future shall continue to be managed as part of the 3-year vegetation management programme.

- Tower bases shall be kept free of all scrub to a distance of 5m from the base.

OHL-03-080 gives detailed specification for OHL vegetation management in SPEN.

Additionally, the preferred OHL route for the project needs to be identified after extensive evaluation of the length of route, biodiversity and geological conservation, landscape and visual amenity (including recreation and tourism), cultural heritage, land use, forestry, and flood risk.

If routing the OHLs in areas of forestry the guideline is to -:

- Avoid areas of landscape sensitivity;

- Not follow the line of sight of important views;

- Be kept in valleys and depressions;

- Not divide a hill in two similar parts where it crosses over a summit;

- Cross skylines or ridges where they dip to a low point;

- Follow alignments diagonal to the contour as far as possible, and;

- Vary in the alignment to reflect the landform by rising in hollows and descending on ridges.

The overall project design objective is to minimise the extent of felling required and woodland areas and individual trees are to be avoided where possible during the routeing phase. Where routeing through woodland has been unavoidable, a 'wayleave' corridor is required for safety reasons to ensure that trees do not fall onto the line and for health and safety of forestry operatives. SPEN has statutory powers to control tree clearance within the wayleave corridor. Where possible the design of the new OHLs and associated infrastructure must be sought to avoid/minimise felling where possible, when balancing with other technical and environmental objectives.

### 6.12. Stakeholder Engagement

SPT is committed to delivering optimal solutions in all the projects it undertakes. A key part of this is engaging with relevant stakeholders throughout the project-development and delivery process. SPT's stakeholder engagement plan for this reinforcement project will be closely aligned to our wider stakeholder engagement commitments as outlined in our RIIO-T3 business plan. Stakeholders includes customers, regulatory bodies and other statutory consultees, national and local government, landowners, community groups, and local residents and their representatives (e.g., MPs, MSPs and councillors). Community impacts associated with construction activities are considered at project initiation by completion of a Community Communications Plan, which details the stakeholders relevant to the project, the communication channels that will be used to engage with them, the information that will be provided to and sought from them, and the timescales over which this will happen. It considers any sensitivities that may require increased stakeholder consultation and details specific events that will be held with stakeholders during the development of the project.

As part of this project, SPT will engage with statutory consultees associated with the planning application for these works - the Local Authority, SEPA and Nature Scot - and the third-party landowner.

Due to the location and nature of this project, no particular sensitivities or community impact issues have been identified, but a general level of interest from local representatives has been noted and we will continue to engage with them throughout the project. Stakeholder engagement to date has informed the details of the construction and permanent drainage details for the works.

### 6.13. Previous Funding Request

SPT's RIIO-T2 licence includes a Price Control Deliverable (PCD) for U & AT Route uprating (OSR SPT200180 TORI-151a U and AT Route Uprating). This proposed the reprofiling of the existing conductor system and minor refurbishment to accommodate the generation background known at that time.

As described in this document, there has been a significant increase in connections activity and the scope of that project was no longer appropriate. The project has been cancelled and superseded by this project, designated as TORI-151b. This has been communicated to Ofgem through annual PCD reporting.

## 7. Eligibility for Competition

Under the RIIO-T3 Business Plan Guidance, Ofgem has requested that projects that are above £50m and £100m should be flagged as being eligible for being suitable for early and late competition respectively. This project is above the £50m threshold, however, is not suitable due to:

- Being significantly developed, therefore not suitable for early competition.
- A number of new connections projects are dependent on the completion date, therefore delays through any project tender exercise will delay these projects.
- A large portion of the works is integral to existing transmission substations and are therefore not identified as separable. Splitting of the project to remove these elements would result in works less than the early competition threshold (£50m).

## 8. Conclusion

This EJP demonstrates the need for a full replacement and circuit uprating of the existing U & AT routes, through examining both load and non-load factors.

The proposed replacement and reinforcement scheme will act as enabling works for the connection of over 800MW of new generation connections in the South East of Scotland by providing new circuits with 282.8MVA pre-fault summer ratings, as well as ensuring the safe operation and future lifespan of the new route with the replacement works.

The seven options considered have been reviewed in terms of scope feasibility, cost, timescales and construction risks with Option 6 demonstrating the primary objective of providing the necessary capacity whilst affording greatest reduction in risk to the network.

In line with the costs prepared, the proposed scope of works and NARM analysis, Option 6 (Rebuild Route with L7 Towers and 2 x AAAC 'UPAS' Conductor) has been identified as the preferred option.

We request that Ofgem approve this needs case under RIIO-T3 submission, with a cost assessment submission to be made at an appropriate time within the period.

## Appendix A – Maps and Diagrams

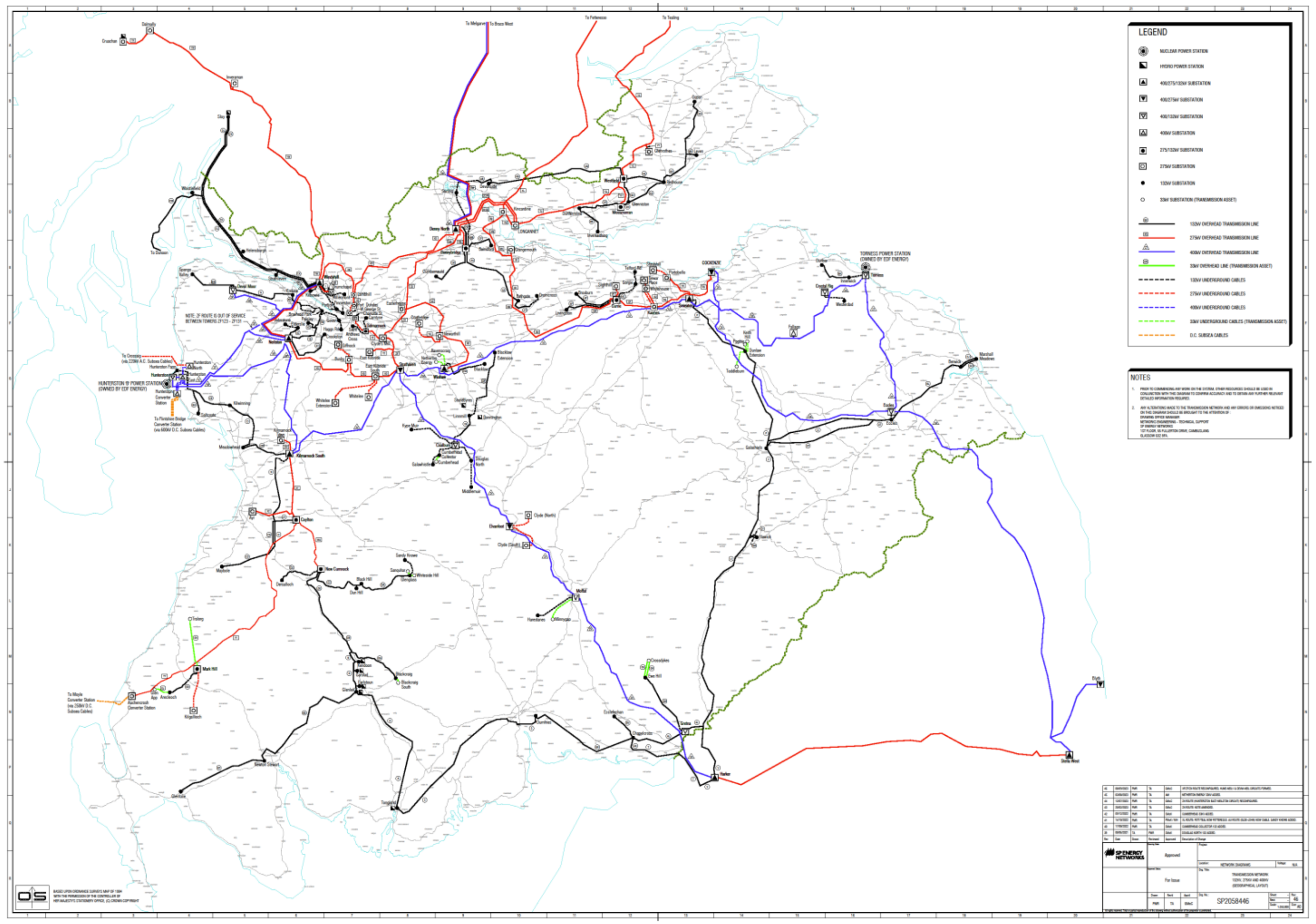


**Figure A- 1: SPT Network Diagram**

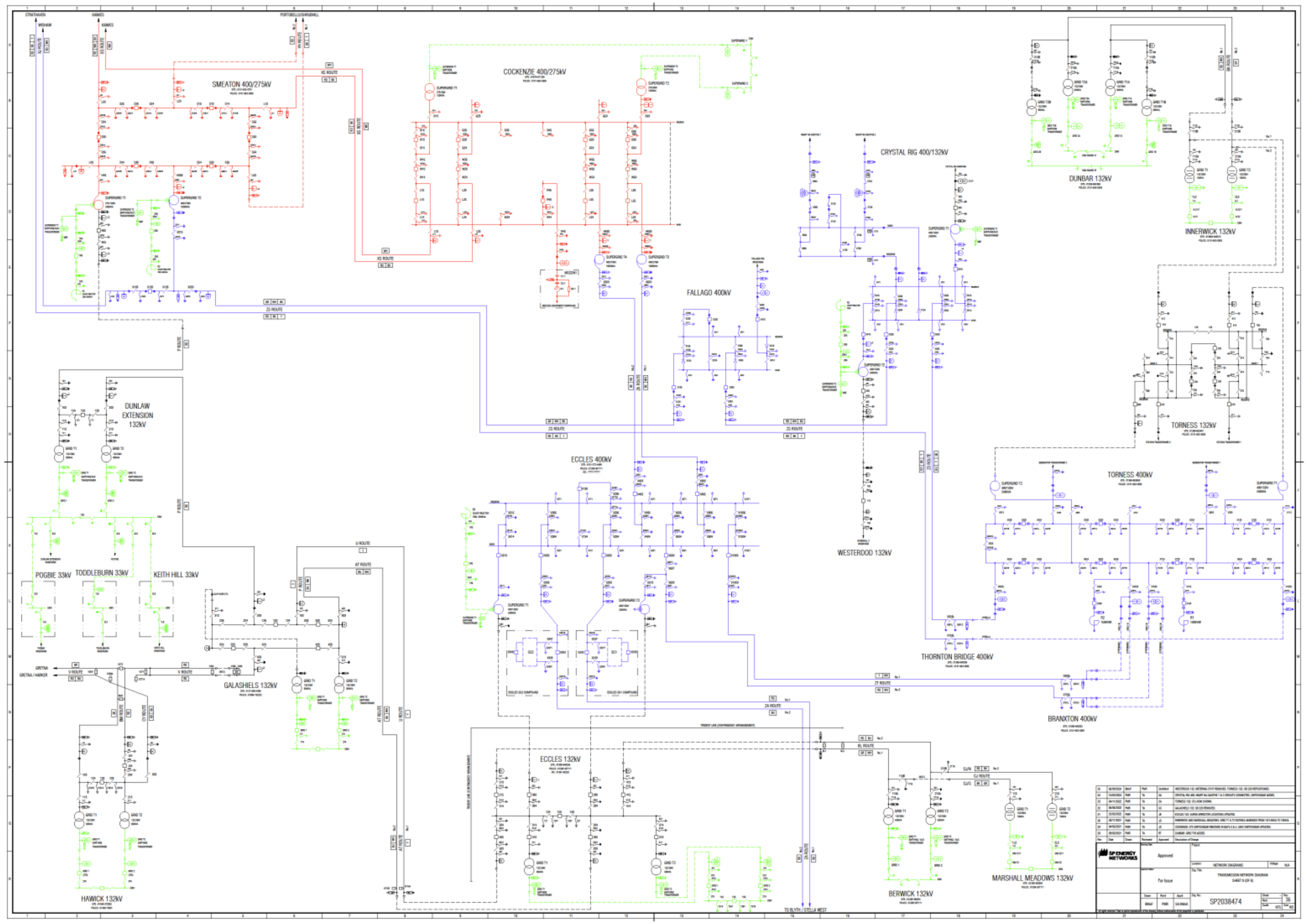


**Figure A- 2: Galashiels - Eccles Surrounding Transmission Network SLD**

## Appendix B – Future Network Arrangement

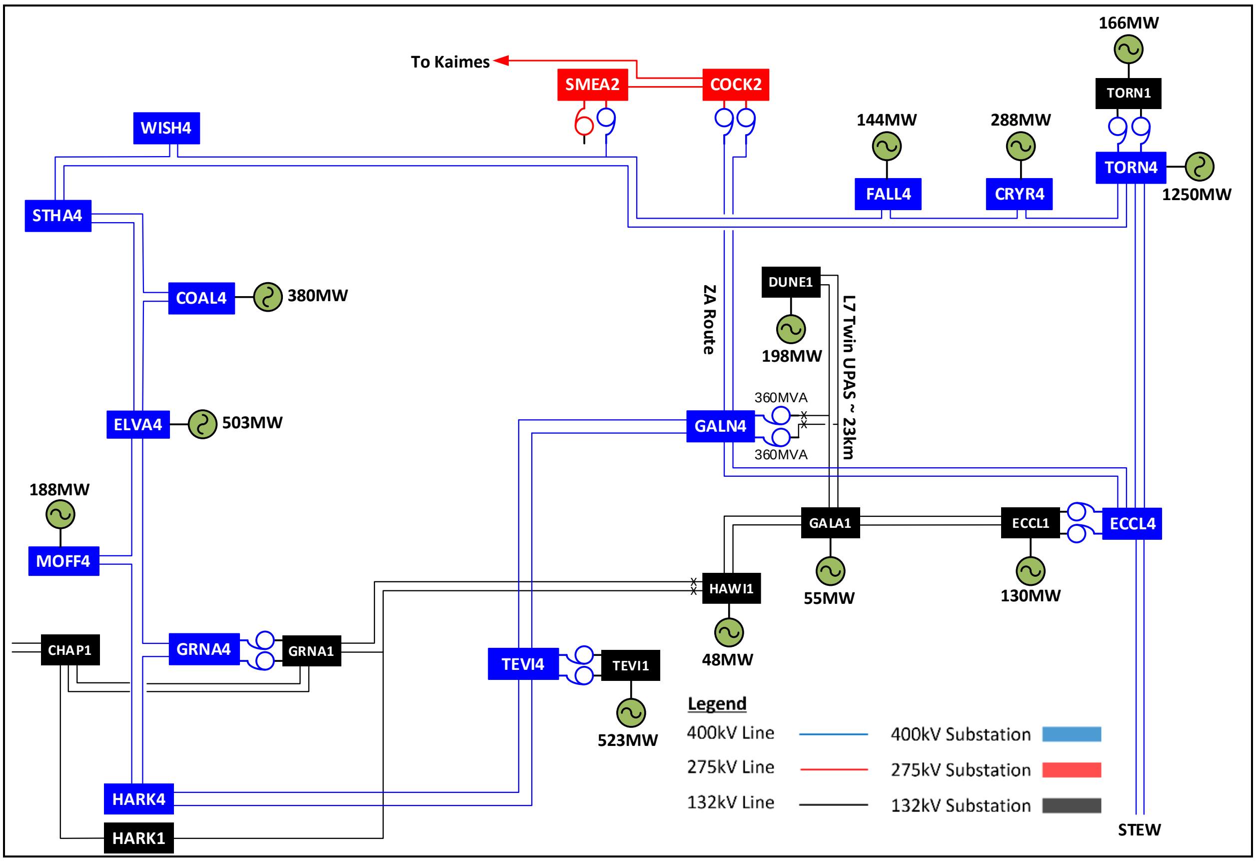


**Figure B - 1: Future Interconnection into Galashiels**

Note: the above is focussed on the works completed under TORIs 151b, 2079 and 2080. All other system configurations are subject to other projects not covered by this paper.

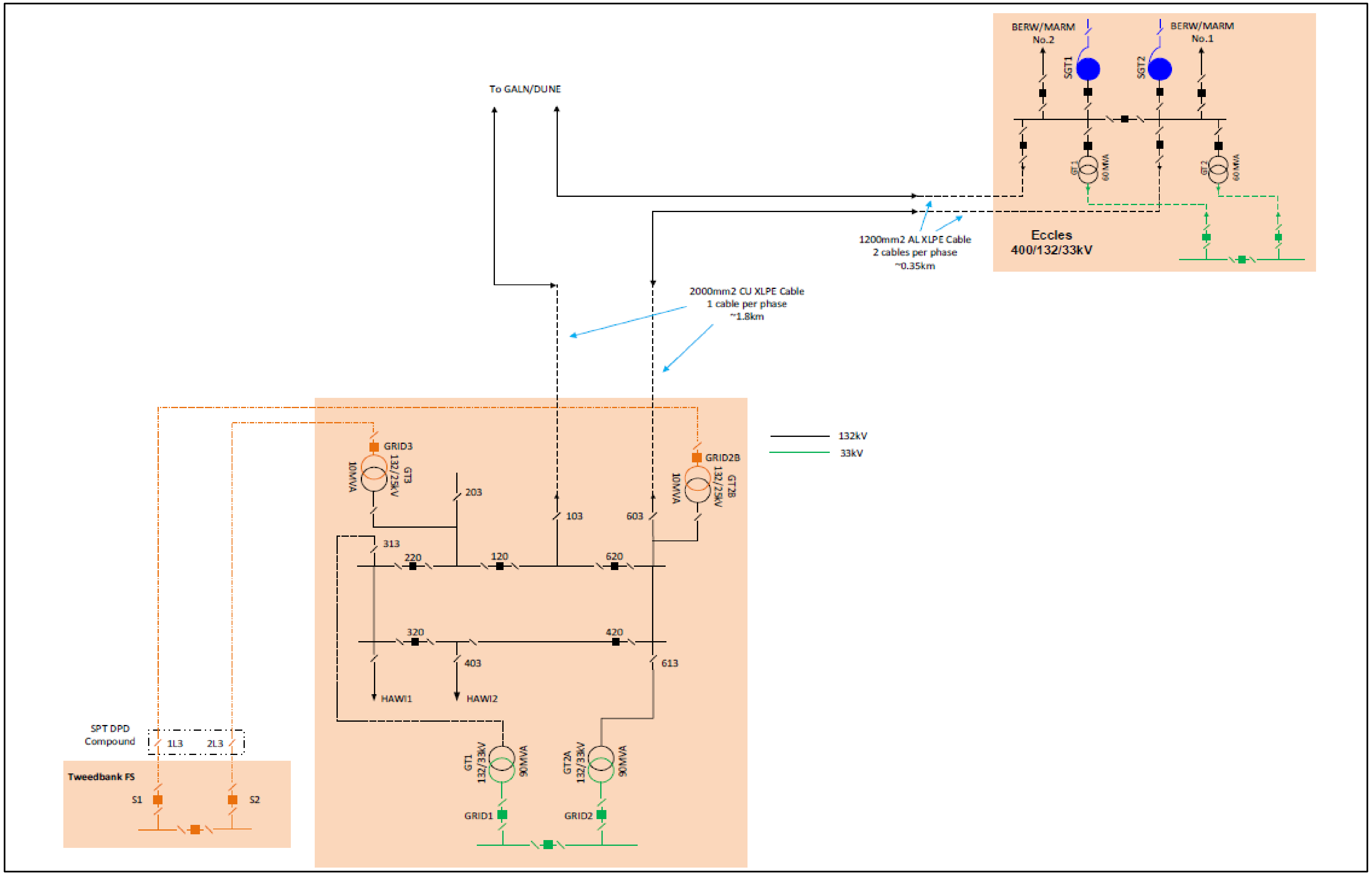


Figure B - 2: Future Connection Arrangement into Galashiels SLD