SP ENERGY NETWORKS

Background to Need Case

2015

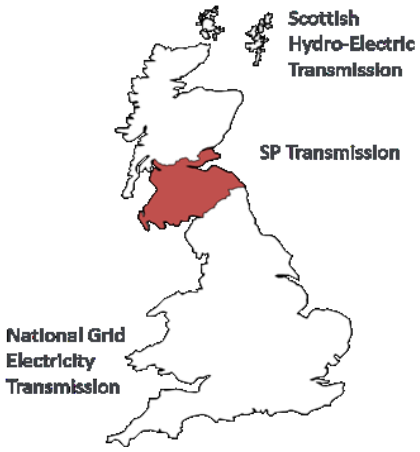
Contents

1 Introduction

1.1 ScottishPower is embarking on a project of significant scale and importance in Dumfries and Galloway for the modernisation and reinforcement of the electricity transmission network. The majority of the transmission network in Dumfries and Galloway was built in the 1930s and is not suitable for the needs of today or the move to a low carbon economy. This document sets out at a high level the reasons why new infrastructure is required and the options we have considered in developing the new network.

2 Background

2.1 SP Transmission plc (SPT) is a wholly owned subsidiary of SP Energy Networks (SPEN), which is part of the ScottishPower Group. Ultimately, SPT is responsible for the transmission of electricity in central and southern Scotland. SPEN's role is to maintain, operate and invest in that network to secure a safe, reliable, and economic service for current and future consumers.



2.2 The SPT Transmission System consists of approximately 4,000 circuit kilometres of overhead line and cable and 132 substations operating at 400kV, 275kV and 132kV serving 1.99 million customers and covering an area of 22,950 square kilometres. It is connected to the Scottish Hydro Electric (SHE) Transmission System to the north, the National Grid Electricity Transmission (NGET) System to the south and the Northern Ireland Transmission System via an HVDC subsea cable.

2.3 SPT is regulated by the Office of Gas and Electricity Markets (Ofgem). They regulate the monopoly elements of the electricity market primarily through price controls. These limit the amount by which electricity companies like SPT can increase costs and stipulate the level of performance we must achieve. Their principal objective is to protect the interests of existing and future electricity and gas consumers i.e. the general public.

2.4 Under the current transmission price control SPT is presently delivering an investment plan in transmission infrastructure totalling £2.6 billion pounds over an 8-year regulatory price control period from April 2013 to March 2021 (Note this regulatory price control period is referred to as RIIO-T1). Along with the other transmission licensees, this is the most significant investment in the transmission network in the last 70 years.

2.5 The electricity system in the UK is going through a transformational change as we move towards a low carbon economy. Traditional large fossil fuel centralised power stations, mostly near the sea, are being replaced by renewable energy that is geographically more spread out.

2.6 The SPT area is crucial to the delivery of the UK Government's renewable energy objectives due to its location in an area of outstanding renewable resource and its position between the SHE Transmission and NGET areas. We have a unique role in connecting renewable generation and bulk transfer of renewable energy from the SHE Transmission and SPT areas into England & Wales. Our activities therefore benefit stakeholders throughout the UK.

2.7 As part of the RIIO-T1 plan, SPEN is proposing a significant investment in the transmission network in the Dumfries & Galloway area to modernise and enhance the transmission infrastructure.

2.8 The existing 132kV network has been unchanged since its construction in the 1930s and has served communities for over 80 years. Significant developments have taken place since then and the needs of the electricity system and its different users have changed in this time. The current network has inadequate capacity and does not meet the requirements of the users, with some assets approaching end of life. We are committed to maintaining a reliable and secure network by making major

investment and improvements to the transmission system in Dumfries and Galloway that will serve both existing and future customers.

2.9 It is proposed to establish a new transmission network supplemented by a much reduced 132kV network. This will serve demand requirements now and in the future, existing generation schemes, and facilitate the connection of new renewable generation to meet the UK's emission targets. All of the new infrastructure will be routed with a strong focus on local population and environmental sensitivities, including visual amenity. We believe this strategic reinforcement should not just be a like-for-like replacement of assets. Instead, it needs to be an investment in a new transmission network fit for the needs of the future. As part of this proposal SPT will also be taking the opportunity to rationalise and remove existing 132kV transmission infrastructure that is no longer required.

2.10 At the time of the RIIO-T1 submission in 2010, it was recognised by Ofgem that a reinforcement solution would be required in this area of the network; however the nature and scope of this solution would require further development. As a result, the project was categorised as Strategic Wider Works (SWW) and Ofgem approved some initial funding to develop the full project scope. SPT is required to submit a formal need case to Ofgem, through the SWW process. Full construction funding will only be granted if Ofgem approve the project need case, with the final scope and timing for delivery being determined through this process. From the work carried out to date, SPT believe that there is a robust need case for an onshore reinforcement solution and this will be detailed in the formal submission to Ofgem towards the end of 2015.

3 Aim of this document

3.1 This document describes the main project drivers and why this investment is needed, along with a summary of the significant work that has been carried out to date.

4 The Network in Dumfries and Galloway

4.1 The electricity transmission system in Dumfries and Galloway is a legacy network that was developed in the 1930s mainly to provide electricity supplies to customers in the area and connect the hydro generation schemes to the wider network. The existing transmission network mainly consists of a 132kV overhead line network that extends from Glenluce in the south west to Newton Stewart, and then Glenlee in the middle of Dumfries and Galloway. Then from Glenlee it extends north towards a substation near Dalmellington in East Ayrshire, and again from Glenlee to the east towards Gretna on the border with England, connecting with the transmission system owned by National Grid in England and Wales. The network is a combination of double circuit and single circuit 132kV overhead lines, as shown on **Figure 1**. A double circuit such as the overhead line between Newton Stewart and Glenlee will have a circuit on either side of a lattice steel tower, **Figure 2**. A single circuit such as the overhead line between Glenlee and Tongland will have a single circuit on a lattice steel tower, **Figure 3**. The total circuit length of the 132kV network in Dumfries and Galloway is around 200km and it serves around 83,000 customers in the area through six Grid Supply Points (GSPs), namely (from east to west) Chapelcross, Dumfries, Tongland, Glenlee, Newton Stewart and Glenluce. The customer base supplied by this network is a typical mix of:

- Strategic Community Services - NHS facilities, water and sewerage facilities, cell phone/communications infrastructure, public lighting and traffic control systems.
- Local Amenities - Health centres, schools, medical practices, dental surgeries.
- Tourism - various sea side resorts, hotels, local shops and restaurants throughout the area.
- Domestic - a typical mix of domestic dwellings covering urban, rural, private sector and social.
- Large Industrial Customers - such as ICI and network rail.
- Renewable energy - such as hydro, wind farm and biomass generators.

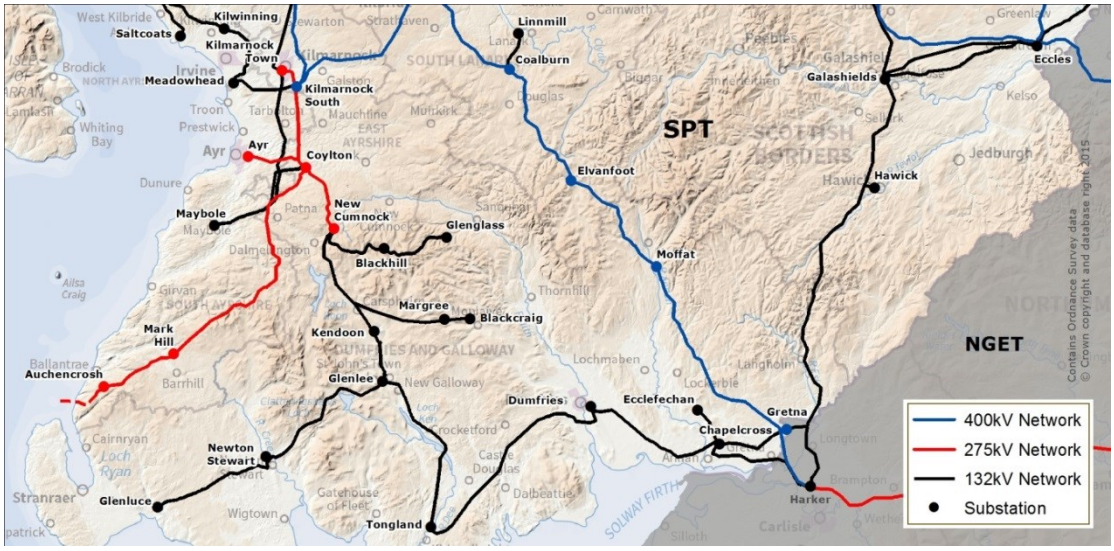


Figure 1: SPT electricity transmission network in South of Scotland

Figure 2: The double circuit 132kV transmission overhead line between Newton Stewart and Glenlee

Figure 3: The single circuit 132kV transmission overhead line between Glenlee and Tongland

5 Asset Replacement

5.1 Within SPT, the company naming convention for transmission overhead lines is for the overhead line route to be identified by a unique letter or letters. The circuits of the N, S and R routes are among the oldest circuits on the network in this area and have served communities and customers in the area for almost eighty years.

5.2 As part of our asset replacement programme, each transmission circuit is given a Health Index (HI) category which identifies the condition of the assets. A new asset, for instance a new double circuit overhead line (OHL), will be given a Health Index 1, whilst an old route reaching end of life will be given a Health Index 5, which is the highest critical rating. The schematic in **Figure 4** shows the network in Dumfries and Galloway with each route and its current health index. It can be seen that the N, R, and S routes (constructed in the 1930s) are categorised as HI5, whilst AL route (constructed in the 1950s) is categorised as HI4 and BR, BT and BG routes (newer routes constructed in the 1960s) are Categorised as HI3. As the assets get older, the need for maintenance work becomes more critical, more difficult and the exposure to unplanned outages (faults) increases. Also the single circuit nature of the N, S and R routes makes access to these assets challenging and exposes the system to significant risks and generation constraints when maintenance outages are taken. The replacement of these assets in the area is essential to provide reliable supplies to existing and future customers.

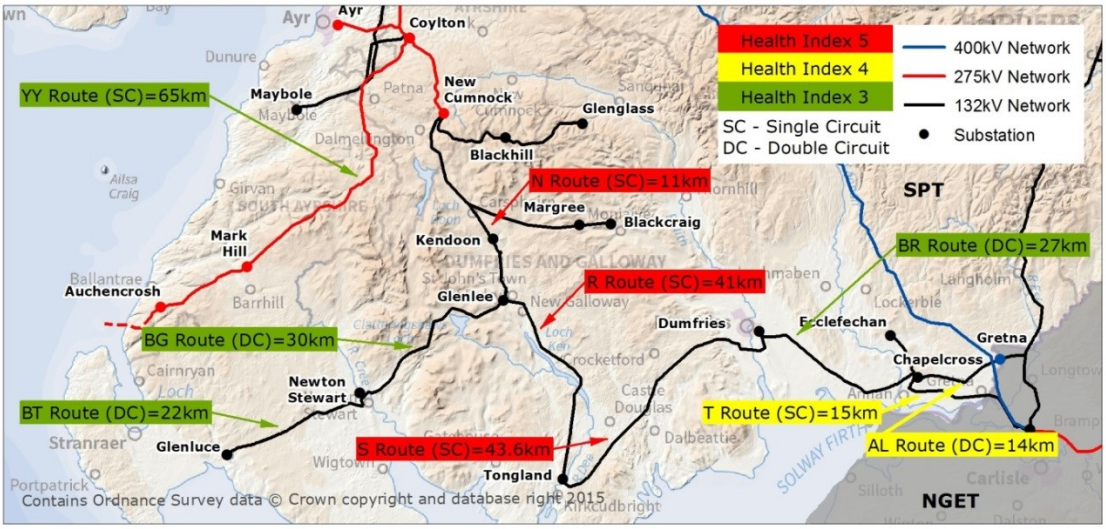


Figure 4: Dumfries and Galloway network asset health

6 Connection of Renewable Generation

6.1 The south west of Scotland is an area rich in renewable resources and significant investment is being made in wind farm development. It is anticipated that renewable generation in excess of 2500 Mega Watts (MW) will be connected to the system over the next decade. A considerable number of these developments are in the Dumfries and Galloway area (currently in excess of 320MW of renewable energy is connected to the system with another 350MW contracted to connect in the future), however the transmission system is no longer capable of supporting this level of renewable generation. **Figure 5** shows the connected and contracted level of generation at the various locations on the system as at 2014. This renewable generation needs to be transferred from the points of generation to areas of demand. The current system in Dumfries and Galloway is severely congested and no capacity is available for the transfer of this energy. The main reason for this is that the existing 132kV network from Glenluce to Gretna has very low capacity with no further head room for connecting new generation. The capacity of the network was designed for the demands and generation requirements of 80 years ago and is no longer capable of supporting the new low carbon economy.

6.2 The new contracted generation will be severely constrained if investment in new infrastructure is not progressed to provide additional capacity for the transportation of this energy from point of generation to areas of demand. The single circuit 132kV network is proving to be a major constraint on the system with no further scope for the new generation to produce energy without restricting their output. It is SPT's license obligation to provide new generation with connection offers that are compliant with system security standards in which the minimum requirements are for these wind farms to be able to export their output under intact system conditions. Therefore the new transmission network needs to be appropriately sized to meet the needs of existing users and also take cognisance of future capacity and wider system connectivity to allow the transfer of this renewable energy.

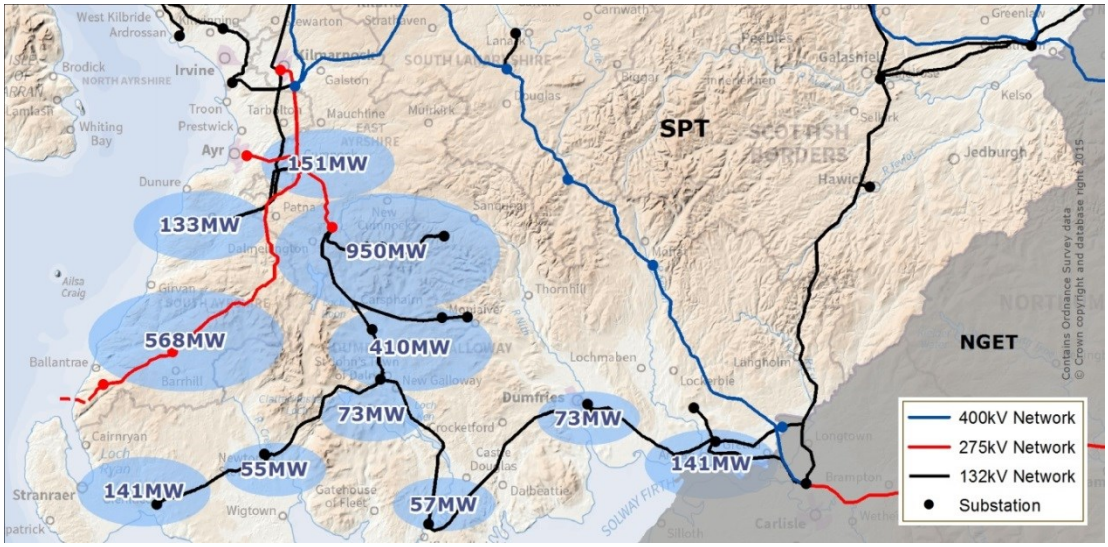


Figure 5: Connected and contracted generation in South West Scotland in 2014

7 Interconnector Capacity

7.1 The GB electricity system is connected to the Irish electricity system through a subsea cable between SPT and the Irish transmission system. This link is referred to as the Moyle interconnector and facilitates the transfer of energy between Great Britain and Ireland. The Moyle interconnector lands at Auchencrosh in South West Scotland where it connects to the SPT system. The interconnector was built in 2000 and, although the current connection agreement allows the import of power to Scotland up to 360MW, from 2018 this import capacity will be limited to 80MW. This is mainly due to the level of renewable generation that is being connected in the Mark Hill area of South West Scotland and limited capacity of the SPT infrastructure. The interconnector has a technical capability to import and export 500MW. However, this cannot be guaranteed from 2018 and a restriction is imposed on the import capacity of the interconnector.

7.2 New European proposals may change the way transmission system interconnectors are treated in the future. The Moyle interconnector may be required to operate to technical limits of 500MW rather than commercial limits. The development of these regulations is still under consideration and their outcome will be assessed accordingly within the final proposals for the Dumfries & Galloway Strategic Reinforcement. The scope of this project could be required to include the transmission infrastructure to meet this increased capability, and the Project has been designed to reflect this at this stage.

8 Network Development and Options

8.1 The network in Dumfries and Galloway needs to be developed with the following three drivers clearly in mind:

- Replacement of ageing assets that are approaching end of life whilst maintaining security of supplies.
- Provision of additional network capacity to enable the connection of renewable generation for the immediate and long term.
- Potentially providing the Moyle interconnector capacity in accordance with its design rather than commercial capability.

8.2 A large number of options were considered as part of the design process, balancing technical, environmental and economic requirements. This range of options can be broadly categorised into three main exit routes for the energy from Dumfries and Galloway, as described below and shown in **Figure 6**:

(i) Reinforcement of the network north of Glenlee into the main 275kV system at Coylton.

(ii) Reinforcement of the network to the south of Glenlee and establishing connectivity to the main transmission system in England through a subsea cable.

(iii) Reinforcement of the network to the east of Glenlee to the main 400kV transmission system at Gretna.

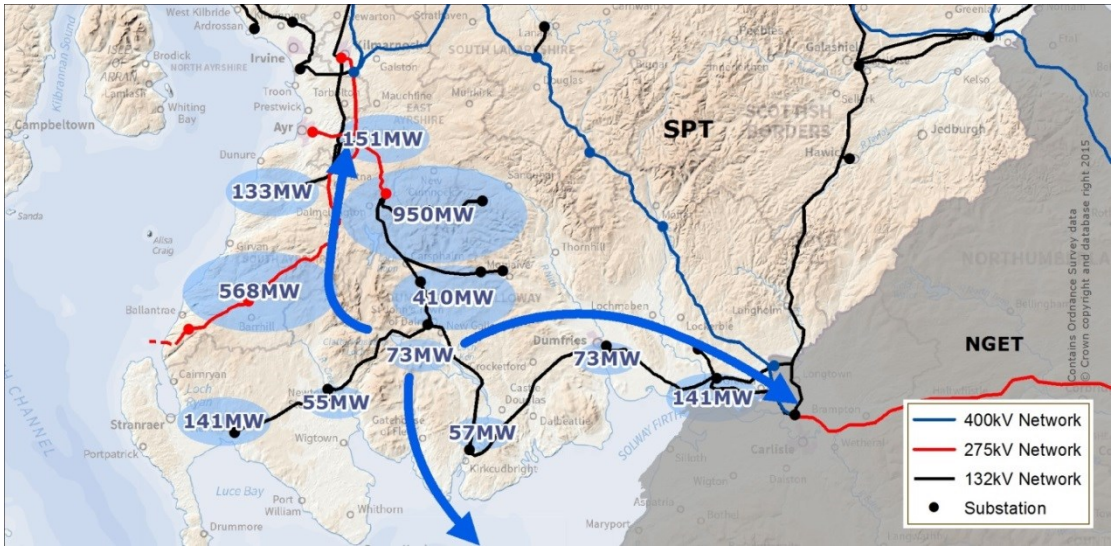


Figure 6: Main exit routes for the renewable generation in Dumfries and Galloway

Option 1

8.3 Initial analysis concluded that reinforcement of the system north of Glenlee would only exacerbate the bottlenecks north of Coylton (at Kilmarnock South and wider 400kV network) due to the significant renewable development in East and South Ayrshire. In excess of 1500MW is either connected or contracted to connect in East and South Ayrshire and the combination of this with the existing generation in Dumfries and Galloway will cause significant congestion to the system out of Kilmarnock South. Furthermore, the energy will flow north to be transferred south again towards areas of demand in England.

Option 2

8.4 The second option considered was to build an offshore subsea cable, connecting the coast of Galloway to the transmission system on the Cumbrian coast. The transfer of power for this option would need to be achieved through an offshore High Voltage Direct Current (HVDC) system. HVDC systems are capital intensive and will require new substation sites close to the shore, both in Scotland and England. Furthermore, onshore reinforcement would still be required to establish a transmission network for harvesting the energy from renewable projects and replace ageing assets. The offshore option was considered and then discounted as cost estimates indicated that this scheme would be significantly more expensive than an onshore equivalent. As a transmission license owner we have an obligation to develop the system in an economic and efficient manner.

Option 3

8.5 The third and preferred option is to reinforce the system to the east of Glenlee such that ageing assets will be replaced, enhanced capacity will be provided for renewable generation and connectivity to the main transmission system in the vicinity of Gretna will be established. **Figure 7** shows the range and scale of options considered in the initial assessment.

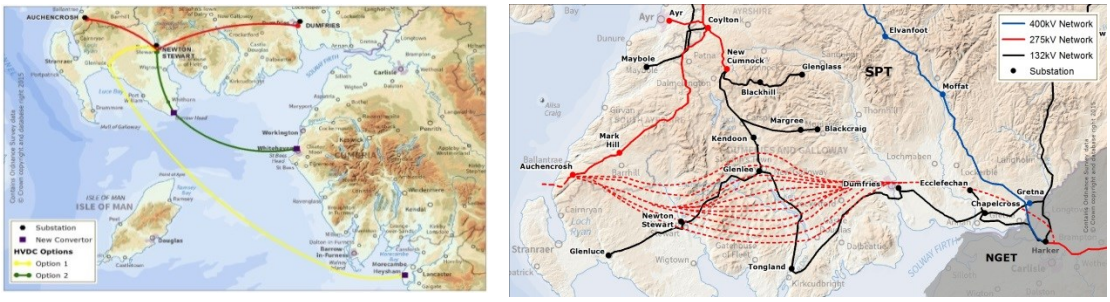


Figure 7: Scope of options considered

8.6 On this basis the preferred system option is to develop an upgraded 'supergrid system' of up to 400kV from Auchencrosh in South Ayrshire, via Glenlee and Dumfries, to Harker in Cumbria. It is proposed that the new electricity network will replace existing end of life infrastructure, provide capacity for future renewable energy connections and support imports from Northern Ireland through the Moyle interconnector.

8.7 At this stage SPEN has identified three distinct stages of infrastructure required to deliver the proposed electricity network upgrade, described below and shown in **Figure 8**:

8.8 **Stage 1:** Harker to Dumfries. Options for connecting the new Dumfries and Galloway network to the main transmission system east of Dumfries were assessed with National Grid, (the transmission system owner in England) and Harker substation emerged as the preferred point of connection.

8.9 **Stage 2:** Tongland Connectivity. Removing the ageing assets means new connectivity to Tongland will be required to ensure supplies are maintained in accordance with standards. It is proposed to build a new 132kV double circuit between Glenlee and Tongland to secure supplies and provide capacity for generation in the area.

8.10 **Stage 3**: Galloway to Auchencrosh. This component will be required to provide new capacity for harvesting the renewable energy in the Newton Stewart and Glenluce areas and establishing connectivity to the Moyle interconnector. To achieve this, the network needs to be extended from Glenlee to Newton Stewart and onto Auchencrosh.

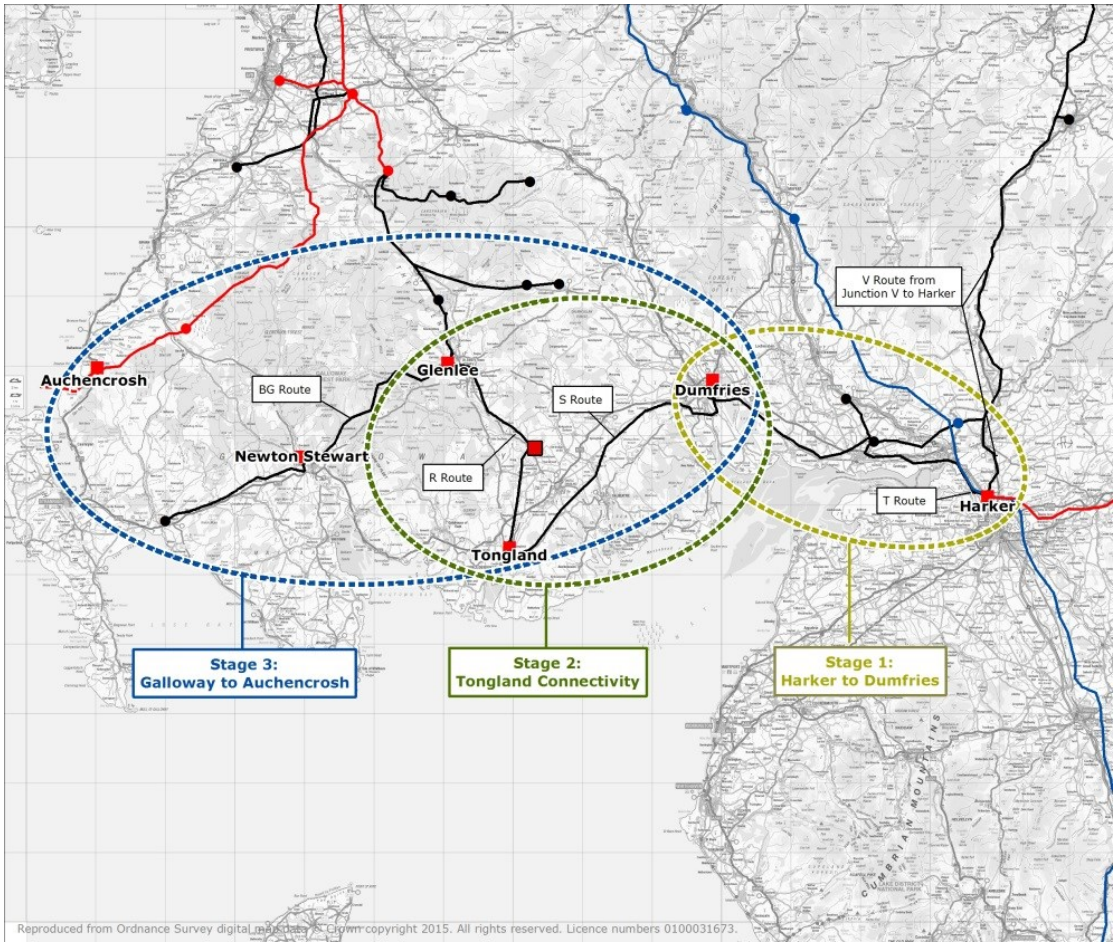


Figure 8: The main three stages for the new network

8.11 At this stage in the network design, various options for network connections and substation locations which met the overarching network requirements were considered. These options comprise differing combinations of overhead line infrastructure sections and substation locations (existing and new) and covered the area as shown in **Figure 9**.

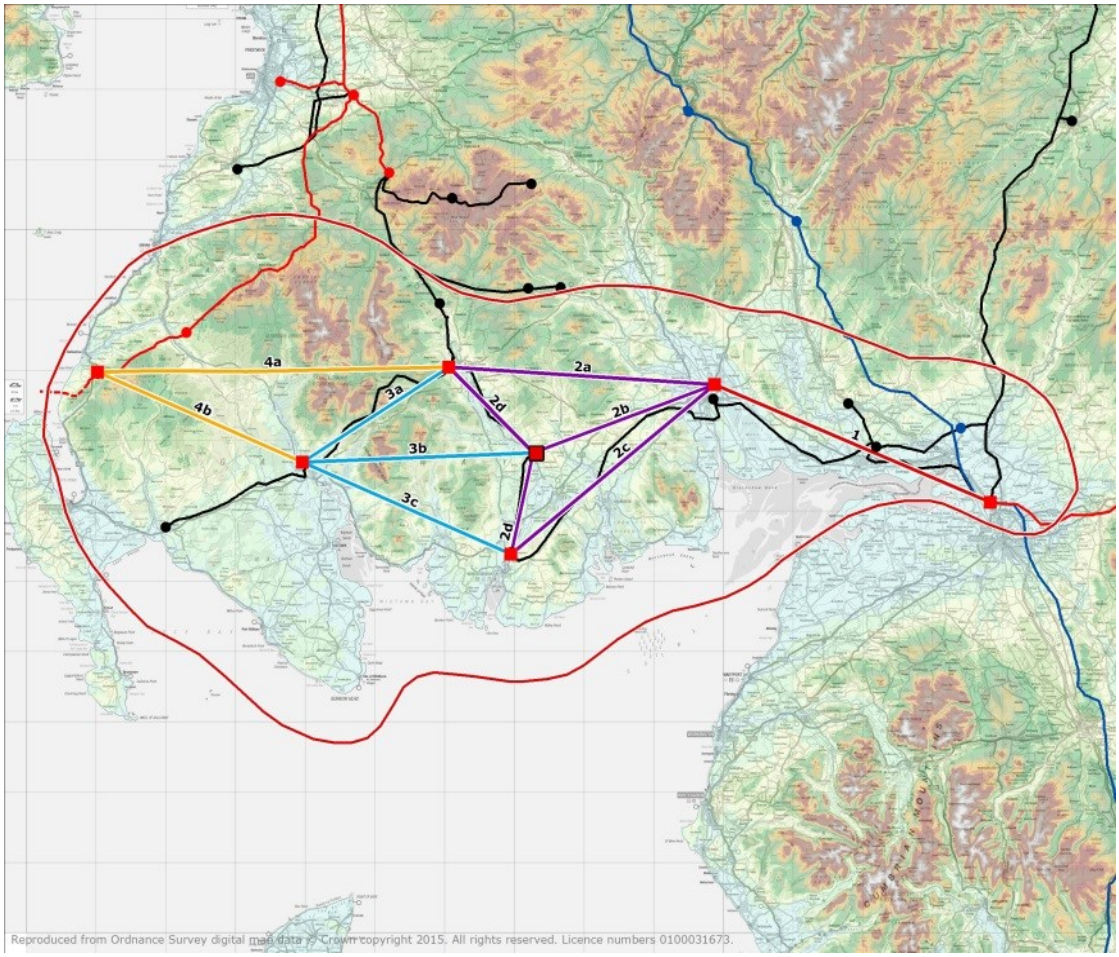


Figure 9: Overhead Line Infrastructure Sections and Substation Locations

8.12 In seeking to develop the new network, the system design had to recognise the environmental characteristics of the region that will influence the network development in terms of substation locations, new overhead lines and rationalisation of existing infrastructure. On this basis a strategic environmental review was undertaken of the various options to identify the environmental viability of the new network. The findings of the strategic environmental review were subsequently reviewed against the technical and design requirements to identify the preferred engineering design solution for the project.

8.13 The staged approach to the development of the network alongside environmental recommendations led to SPEN's current view of the preferred solution. This preferred engineering design solution, as shown in **Figure 10**, will require the establishment of a transmission system of up to 400kV that runs from Harker in the east, to Auchencrosh in the west. The network will require new substations at critical points on the system in the vicinity of Dumfries, Glenlee, Newton Stewart and Auchencrosh. At the same time a new 132kV overhead line double circuit will be extended from Kendoon North substation southwards to Glenlee and to Tongland. The new network will ensure security of supply is maintained and connection of renewable energy is facilitated. It will also enable the removal of ageing assets (shown in bold) and rationalisation of some of the existing double circuit 132kV network.

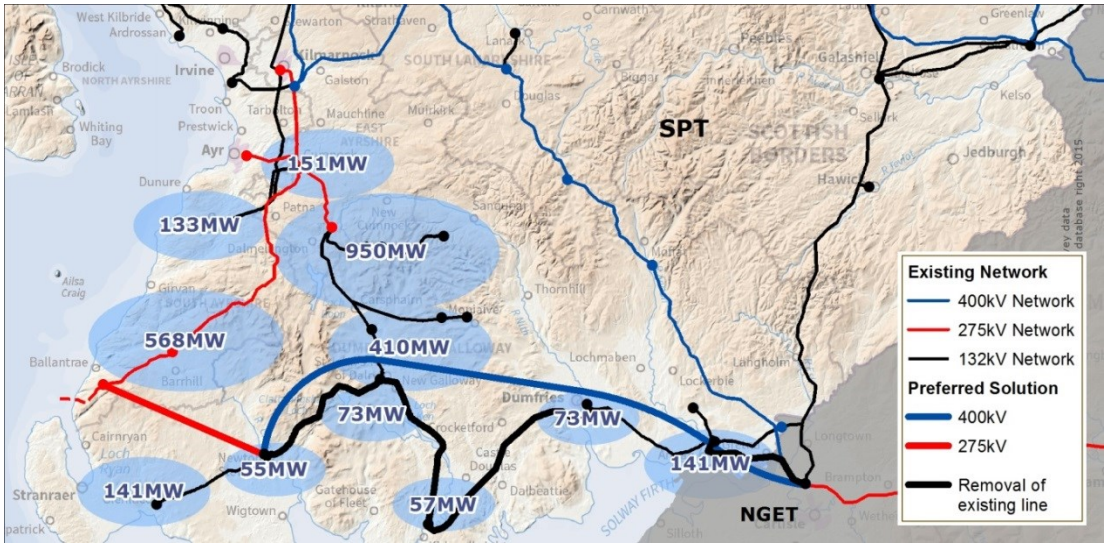


Figure 10: Emerging preferred solution for the Dumfries and Galloway network

9 Summary

9.1 Investing in new infrastructure is driven by customer needs, whether security of supply, demand growth or connecting new generation. Our purpose and license obligation is to develop and maintain an efficient, coordinated and economical electricity transmission system for existing and future consumers. Therefore, we believe the network in Dumfries and Galloway needs to be modernised to replace ageing assets and to be reinforced to provide additional capacity for new generation. We have maximised the utilisation of the existing system but now new infrastructure is required to connect renewable generation and support the move to a low carbon economy. We have identified different options taking into consideration technical requirements and the environmental characteristics of the region. The emerging preferred solution comprises a new transmission system of up to 400kV that runs from Harker in the east to Auchencrosh in the west, via new substations in the vicinity of Dumfries, Newton Stewart, Glenlee and Auchencrosh, with a new 132kV overhead line from Kendoon to Tongland. This solution will enable the replacement of ageing assets and provide capacity for consumers today and for future generations to come.

10 Glossary

Angle or Tension Pole/Tower: a tower or pole erected to allow for a change in direction of the line.

Conductor: a metallic wire strung from tower to tower or pole to pole, to carry electric current.

Circuit: a combination of conductors (commonly three conductors) along which electricity is transmitted or distributed.

Earth Wire: a wire erected above the topmost conductor at the tower peak or under slung on a wood pole. These are used for protection against lightning strikes but can also contain fibre optic cores for communication purposes.

Environmental Impact Assessment (EIA): a formal process used to identify, predict and assess the likely environmental effects of a proposed development.

Environmental Statement (ES): the document which reports the findings of an EIA.

Holford Rules: accepted guidance for routeing overhead lines in the UK.

Insulators: articulated strings made of either glass or polymeric compound. These are required to prevent electric current crossing to a tower or pole body.

Interconnector: An interconnector is a structure which enables energy to flow between networks. The term is used more specifically to refer to international connections between electricity and natural gas networks.

Kilovolt (kV): One thousand (1000) volts.

Major Electrical Infrastructure Project: a development of overhead lines, underground cables and substations at 132kV and above.

Nationally Significant Infrastructure Project (NSIP): a major infrastructure development in England and Wales, defined in The Planning Act, 2008.

Overhead Line: an electric line installed above ground, usually supported by lattice steel towers or wooden poles.

Preferred Route: a route taken forward to stakeholder consultation following a comparative review of route options.

Proposed Route: a route taken forward to the EIA stage following stakeholder consultation.

Route Alignment: the alignment of the route which forms the basis of the application for consent.

Route Options: a number of routes between the start and end connection points, may be several hundred metres wide.

Span: the section of overhead line between two towers or two wood poles.

SP Energy Networks (SPEN): part of the ScottishPower Group of companies. SPEN transmits and distributes electricity to around 3.5 million customers in the South of Scotland, Cheshire, Merseyside, North Shropshire and North Wales.

SP Transmission plc (SPT): a wholly owned subsidiary of SPEN. SPT is responsible for the transmission of electricity in central and southern Scotland.

Study Area: the area within which the routeing study takes place.

Substation: controls the flow and voltage of electricity by means of transformers and switchgear, with facilities for control, fault protection and communications.

Terminal Pole/Tower: a tower or pole required where the line terminates either at a substation or at the end of an underground cable.

The National Grid: the electricity transmission network in the UK.

Transformers: Substation components used to increase or decrease the voltage of electricity.

Volts: the international system unit of electric potential and electromotive force.