SP Energy Networks

Cross Border Connection:

Gala North Substation to the Scottish Border

Routeing and Siting Consultation Document

September 2024

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Glossary and Abbreviations

Glossary

AIS Substation	AIS substations use air as the insultation medium for electrical equipment.
Border	The border between Scotland and England
CMNC	The term used to describe in the Project in NOA documents published in January 2021 and January 2022 as well as the NOA Refresh published July 2022
CMN3	The term used to describe in the Project in the transitional Centralised Strategic Network Plan 2 which was published in March 2024
Connection Point	The point in NGET's licence area where the Project will connect to the National Electricity Transmission System in the northwest of England.
Crossing Point	The point on the Scotland-England border where the Cross Border Connection crosses over from Scotland to England (or vice versa)
GIS Substation	GIS substations use gas as the insultation medium for electrical equipment
National Grid Electricity System Operator (NGESO)	NGESO is the electricity system operator for Great Britain. It supports and guides the development of the electricity transmission system as well as it operates it ensuring that supply and demand are balanced.
National Grid Electricity Transmission (NGET)	NGET is a Transmission Licence Holder under the Electricity Act 1989. It owns and maintains the high voltage electricity network (275 and 400kV) in England and Wales.
The NGET Project	The components of the Cross Border Connection within NGET's licence area, from the Scotland-England border to a connection in the northwest of England..
Network Options Assessment (NOA)	An economic assessment of electricity transmission projects proposed by Transmission Owners to provide network capacity and meet the future needs of the electricity transmission network.
Overhead line	Conductors or 'wires' which are suspended at a specified height above ground and carried by wood poles or steel lattice towers
The Project	The Cross Border Connection project from the proposed Gala North Substation in south of Scotland to a connection point in the Carlise area in the northwest of England.
SP Energy Networks	SP Enegy Networks owns and operates the electricity transmission and distribution networks in central and southern Scotland through its wholly-owned subsidiaries SP Transmission plc and SP Distribution plc.

The SP Energy Networks Project	The components of the Cross Border Connection within SP Transmission's licence area, from the proposed Gala North Substation to the Scotland-England border.
SP Transmission	SP Transmission is a Transmission Licence Holder under the Electricity Act 1989. It owns and maintains the high voltage electricity network (132, 275 and 400kV) in central and southern Scotland.
Steel Lattice Tower	Structure used to carry overhead line electrical conductors ('wires'), insulators and other fittings.
Substation	Substations manage and control electricity flows on the network including transforming voltages and allowing energy to be transmitted or distributed.

Abbreviations

AIS	Air Insulated Switchgear
AWI	Ancient Woodland Inventory
CBC	Cross Border Connection
CEGB	Central Electricity Generating Board
CES	Crown Estate Scotland
D&GC	Dumfried and Galloway Council
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
ECU	Energy Consents Unit
ENA	Electricity Networks Assocation
FLS	Forest and Land Scotland
GB	Great Britain
GCR	Geological Conservation Review
GDL	Garden and Designed Landscape
GIS	Gas Insulated Switchg\ear
GW	gigawatt
HND	Holistic Network Design
km	kilometre
kV	kilovolt
LBS	Local Biological Sites
LCA	Landscape Character Area
LCT	Landscape Character Type

LDP	Local Development Plan
LNCS	Local Nature Conservation Sites
LPA	Local Planning Authority
m	metre
mAOD	metres Above Ordnance Datum
MOD	Ministry of Defence
MW	megawatt
NESO	National Energy System Operator
NETS	National Electricity Transmission System
NGESO	National Grid Electricity System Operation
NGET	National Grid Electricity Transmission
NOA	Network Options Assessment
NPF	National Planning Framework
NSA	National Scenic Area
NWSS	Native Woodland Survey of Scotland
Ofgem	Office of Gas and Electricity Markets
OHL	Overhead Line
RSA	Regional Scenic Area
RSCD	Routeing and Siting Consultation Document
SAC	Special Area of Conservation
SBC	Scottish Borders Council
SLA	Special Lansdcape Area
SPA	Special Protection Area
SPEN	SP Energy Networks
SPT	SP Transmission
SSEN	Scottish and Southern Electricity Networks
SSSI	Site of Special Scientific Interest
SWT	Scottish Wildlife Trust
TCE	The Crown Estate
tCSNP	Transitional Centralised Strategic Network Plan
TO	Transmission Owner
TTA	Tactical Training Area
UGC	Underground Cable
UK	United Kingdom

01.
Introduction

1. Introduction

1.1 Introduction

This Routeing and Siting Consultation Document has been prepared by AECOM on behalf of SP Energy Networks[1]. It informs the development of a new cross-border double circuit 400 kilovolt (kV) overhead line (OHL) between Gala North Substation in the southeast of Scotland and a connection point to the electricity transmission system in the northwest of England (hereafter referred to as the 'Cross Border Connection' or 'the Project'). While the Project is being jointly developed by SP Energy Networks and National Grid Electricity Transmission (NGET), the Document describes the approach to and results of a routeing and siting study considering the Project components in Scotland only (referred to as the 'SP Energy Networks Project' in this document). These comprise:

- A new double circuit 400kV OHL between the proposed Gala North Substation and a new Teviot Substation,
- The new Teviot Substation which will also connect the proposed Teviot and Liddesdale (also referred to as Borders) Wind Farms to the electricity transmission network, and
- A new double circuit 400kV OHL from the new Teviot Substation to the Scotland-England border where the Cross Border Connection would enter NGET's licence area.

The objective of the routeing and siting study has been to identify and assess alternative route and site options for the new OHLs and Teviot Substation and identify a Preferred Option to be taken forward to be consulted on and developed through subsequent stages. It should be noted that NGET will be undertaking complementary activities with regard to the components of the Cross Border Connection in its licence area in England and that further work may be required to confirm where the Cross Border Connection crosses the Scotland-England border in light of NGET's work. Figure 1 at the end of this section provides an overview of the general geography of the SP Energy Networks Project including the location of the proposed Gala North Substation and proposed Teviot Wind Farm as well as existing electricity transmission network infrastructure in the region.

1.2 Background to the Project

The UK and Scottish Governments have set legally binding targets to reach net zero in greenhouse gas emissions and end their contributions to climate change by 2050 and 2045 in the Climate change Act 2008 and Climate Change (Scotland) Act 2009 respectively. Decarbonisation of the energy sector is a central pillar of both governments' net zero strategies meaning the way in which energy is generated, transported and used is undergoing transformational change. Traditional fossil fuel-based forms of generation are being retired

[1] SP Energy Networks is the trading name for Scottish Power Energy Network Holdings Limited. It owns and operates the electricity transmission and distribution networks in central and southern Scotland through its wholly-owned subsidiaries SP Transmission plc and SP Distribution plc. These businesses are 'asset-owner companies' holding the regulated assets and Electricity Transmission and Distribution Licenses. SP Transmission plc is the transmission licensee.

and replaced by renewable and low carbon sources of energy generation including onshore and offshore wind as well as being supported by increased interconnection with Europe.

Offshore wind is a critical component of the UK Government's energy strategy with targets to increase installed capacity from around 10 gigawatts (GW) today to 40GW by 2030 originally being set in the Energy White Paper (2020)[2], and then increased to 50GW by 2030 in the British Energy Security Strategy (2022)[3]. The scale of the offshore wind development pipeline is also reflected in the most recent seabed leasing rounds; Round 4 (2021) overseen by The Crown Estate (TCE) and ScotWind (2022) overseen by Crown Estate Scotland (CES) have awarded seabed leasing rights for 8GW in English Waters and 25GW in Scottish Waters respectively.

In 2023 the Scottish Government consulted on its draft Energy Strategy and Just Transition Plan[4]. The draft Strategy sets out objectives for Scotland to increase production of renewable energy including 8-11GW of installed offshore wind capacity by 2030 and an additional 12GW of installed onshore wind capacity by 2030. This is consistent with the Scottish Government's Onshore Wind Policy Statement (2022)[5] which also sets out a target to achieve a minimum of 20GW of installed capacity of onshore wind in Scotland by 2030. The 20GW target was most recently reaffirmed in late 2023 with the publication of the Onshore Wind Sector Deal[6] which sets out commitments from the Scottish Government and the onshore wind industry to deliver on the 2030 target.

To facilitate renewable forms of generation supported by UK and Scottish Government policy and targets such as offshore and onshore wind, new electricity network infrastructure is needed to ensure that energy can be transported from where it is generated to where it is used. Traditionally the electricity transmission system was developed to transport electricity in bulk from power stations to cities and towns where it is transported via the electricity distribution network, but as renewable energy sources are typically located in more geographically remote and/or disparate locations this requires new electricity network infrastructure both to connect it to the network as well as to transport it to areas of demand.

With electricity demand predominantly located in the south of the Great Britain and considerable renewable energy resources in the north this leads to high north-south power flows on the electricity transmission system. Reflecting prevailing policy objectives and the pipeline of offshore and onshore wind and other renewable energy projects in Scotland this requires an increase in cross-border electricity transmission capability so that energy can be transported to areas of increased demand further south in Great Britain and to avoid constraints on the system.

[2] Energy White Paper (2020), UK Government https://www.gov.uk/government/publications/energy-white-paper-powering-our-net-zero-future/energy-white-paper-powering-our-net-zero-future-accessible-html-version
[3] British Energy Security Strategy (2022), UK Government https://www.gov.uk/government/publications/british-energy-security-strategy/british-energy-security-strategy
[4] Draft Energy Strategy Just Transition Plan (2023), Scottish Government https://www.gov.scot/publications/draft-energy-strategy-transition-plan/
[5] Onshore Wind Policy Statement (2022), Scottish Government https://www.gov.scot/publications/onshore-wind-policy-statement-2022/
[6] Onshore Wind Sector Deal (2023), Scottish Government https://www.gov.scot/publications/onshore-wind-sector-deal-scotland/

SP Transmission, the Transmission Owner (TO) and Licence Holder responsible for the electricity transmission network in central and southern Scotland therefore has a crucial role to play. Its transmission network enables the bulk transfer of renewable energy generated within its licence area as well as that generated within SSEN Transmission's (SSENT) licence area to the north, southwards to NGET's licence area and large centres of demand.

1.3 SP Transmission's Statutory Duties and Licence Obligations

As the holder of a transmission licence under the Act, SP Transmission is subject to a number of statutory duties and licence obligations. These include requirements "*to develop and maintain an efficient, coordinated and economical system of electricity transmission*" and "*to facilitate competition in the generation and supply of electricity*". This requires SP Transmission to provide for new electricity generators such as wind farm developers wishing to connect to the transmission system in its licence area; to make its transmission system available for these purposes and to ensure that the transmission system is fit for purpose through appropriate reinforcements to accommodate the contracted capacity.

In addition, in formulating proposals for electricity transmission infrastructure, SP Transmission is subject to duties under Schedule 9 of the Act: "*(a) to have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and, (b) to do what it reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects.*"

SP Energy Networks, acting on behalf of SP Transmission, is undertaking further studies including this routeing and siting study to inform the development of the Project. This work is undertaken in accordance with SP Transmission's statutory duties and licence obligations with the objective of ensuring that the Project is technically feasible, economically viable and on balance, causes the least disturbance to both the environment and the people who live, work and enjoy recreation within it.

1.4 Need for the SP Energy Networks Project

As described in the previous section, SP Transmission has a number of statutory duties and licence obligations which underpin the need for the SP Energy Networks Project; firstly reinforcing the network to increase cross-border network capacity and enable increased north-south flows on the transmission system and secondly, facilitating the connection of proposed wind farms in the Scottish Borders.

Need for the Network Reinforcement

The SP Energy Networks Project forms part of a wider cross-border scheme being jointly developed by SP Energy Networks and NGET. The need for network reinforcement such as the Cross Border Connection is assessed by National Grid Electricity System Operator (NGESO)[7], the electricity system operator for Great Britain, as part of a number of activities it undertakes on annual basis to ensure the economic and efficient operation of the electricity

[7] NGESO will become the National Energy System Operator (NESO) during 2024: https://www.nationalgrideso.com/what-we-do/becoming-national-energy-system-operator-neso

transmission system. These include the Network Options Assessment (NOA), an economic assessment of projects proposed by TOs to provide network capacity and meet the future needs of the electricity transmission network. The analysis in NOA allows recommendations to be made as to which projects will be economic and efficient to develop and the optimal timing of those projects.

The Cross Border Connection has evolved over a number of years. It was first identified in the NOA as 'CMNC' where it was described as an onshore reinforcement from southeast Scotland to northwest England. CMNC was given a 'proceed' signal in successive NOA documents published in January 2021[8] and January 2022[9]. Subsequently the NOA Refresh[10] was published July 2022 in parallel with the publication of the Holistic Network Design (HND). This set out a blueprint for the connection of offshore wind needed to meet the Government's 2030 targets (also referred to as the 'Pathway to 2030'), and also recommended the development of 'CMNC'.

More recently the need for the Project was re-evaluated as part of the development of the transitional Centralised Strategic Network Plan 2 (tCSNP2)[11] (also referred to as 'Beyond 2030'). This was published in March 2024 and recommended the development of 'CMN3', a cross-border reinforcement between southeast Scotland and northwest England increasing north-south network capability while also increasing access to the transmission network for generators in the Borders area. Since then, SP Energy Networks and NGET have been working jointly to develop 'CMN3', now known as the Cross Border Connection.

Need for the Wind Farm Connections

The SP Energy Networks Project will connect a number of wind farms under development in southern Scotland via Teviot Substation, including the proposed Teviot Wind Farm and Borders Wind Farm:

- The developers of the proposed Teviot Wind Farm, Muirhall Energy, have a contract with NGESO and SP Transmission to provide a 522.9 megawatt (MW) connection to the electricity transmission system by 2033. The proposed Teviot Wind Farm is subject to a separate consent application under section 36 of the Electricity Act 1989 which is pending consideration[12].
- EDF Energy, the developers of Borders Wind Farm (also known as Liddesdale Wind Farm), have a contract with NGESO and SP Transmission to provide a 400MW connection to the electricity transmission system by 2033. The proposed Borders Wind Farm is also subject to a separate consent application under section 36 of the Electricity Act 1989.

[8] Network Options Assessment (January 2021), NGESO
https://www.nationalgrideso.com/document/185881/download
[9] Network Options Assessment (January 2022), NGESO
https://www.nationalgrideso.com/document/233081/download
[10] Network Options Assessment Refresh, NGESO (July 2022)
https://www.nationalgrideso.com/document/262981/download
[11] Transitional Centralised Strategic Network Plan 2 (March 2024), NGESO
https://www.nationalgrideso.com/document/304756/download
[12] Teviot Wind Farm Consent Application, Muirhall Energy
https://www.energyconsents.scot/ApplicationDetails.aspx?cr=ECU00003249&T=0

No application has been submitted as yet, however the developer has requested a Scoping Opinion[13].

1.5 Development and Consenting of the SP Energy Networks Project

The approach taken to developing the SP Energy Networks Project comprises the following key phases:

- Phase 1. Routeing. Phase 1 comprises this routeing and siting study in which alternative route and site options for the Project components are identified and assessed taking into account a range of environmental, technical and economic considerations in line with SP Transmission's statutory duties. It concludes with the identification of a Preferred Option which is then subject to consultation (referred to as Phase 1 Consultation). SP Energy Networks is committed to ongoing consultation with interested parties, including statutory and non-statutory consultees and local communities. Whilst there is no statutory requirement to consult during the early routeing and siting stages, SP Energy Networks consider it good practice to introduce consultation at this stage. Responses to consultation will be evaluated and inform confirmation of a Proposed Option to be taken forward to Phase 2.
- Phase 2. Environmental Impact Assessment (EIA). The Cross Border Connection, including the SP Energy Networks Project will require to be subject to EIA. Specifically, the SP Energy Networks Project will be subject to EIA under the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017. Through Phase 2 the EIA process seeks to identify, assess and mitigate the likely significant adverse effects of the SP Energy Networks Project on the environment. The EIA process comprises several steps starting with scoping and concluding with the production of an EIA Report (EIAR) which will accompany the application for consent. During this phase SP Energy Networks will also undertake a second round of public consultation (referred to as Phase 2 Consultation) on the detailed design of the SP Energy Networks Project.
- Phase 3. Application for Consent. SP Energy Networks will be applying to the Scottish Ministers for consent under Section 37 of the Electricity Act 1989, as amended, to install, and keep installed, the SP Energy Networks Project. The EIAR will accompany the application for Section 37 consent. At the same time, SP Energy Networks will also apply to Scottish Ministers for deemed planning permission under Section 57(2) of the Town and Country Planning (Scotland) Act 1997, as amended, for the SP Energy Networks Project including ancillary development. While the Scottish Ministers will be responsible for the decision to approve the SP Energy Networks Project or not, in reaching their decision they will consult with statutory stakeholders, relevant Local Planning Authorities (LPAs) and members of the public.

[13] Borders Wind Farm (referred to as Liddesdale Wind Farm) Scoping Opinion Request, EDF Energy https://www.energyconsents.scot/ApplicationDetails.aspx?cr=ECU00004833

1.6 Purpose and Structure of this Document

The primary purpose of this document is to report on Phase 1 of the SP Energy Networks Project; the routeing and siting study which has been undertaken in order to identify a Preferred Option. The Routeing and Siting Consultation Document has been published in parallel with the start of public consultation on the SP Energy Networks Project. The objective of this is to seek feedback on the Preferred Option from statutory and non-statutory consultees, as well as local communities and use this feedback to inform subsequent stages of the development and assessment of the SP Energy Networks Project ahead of making the relevant consent applications.

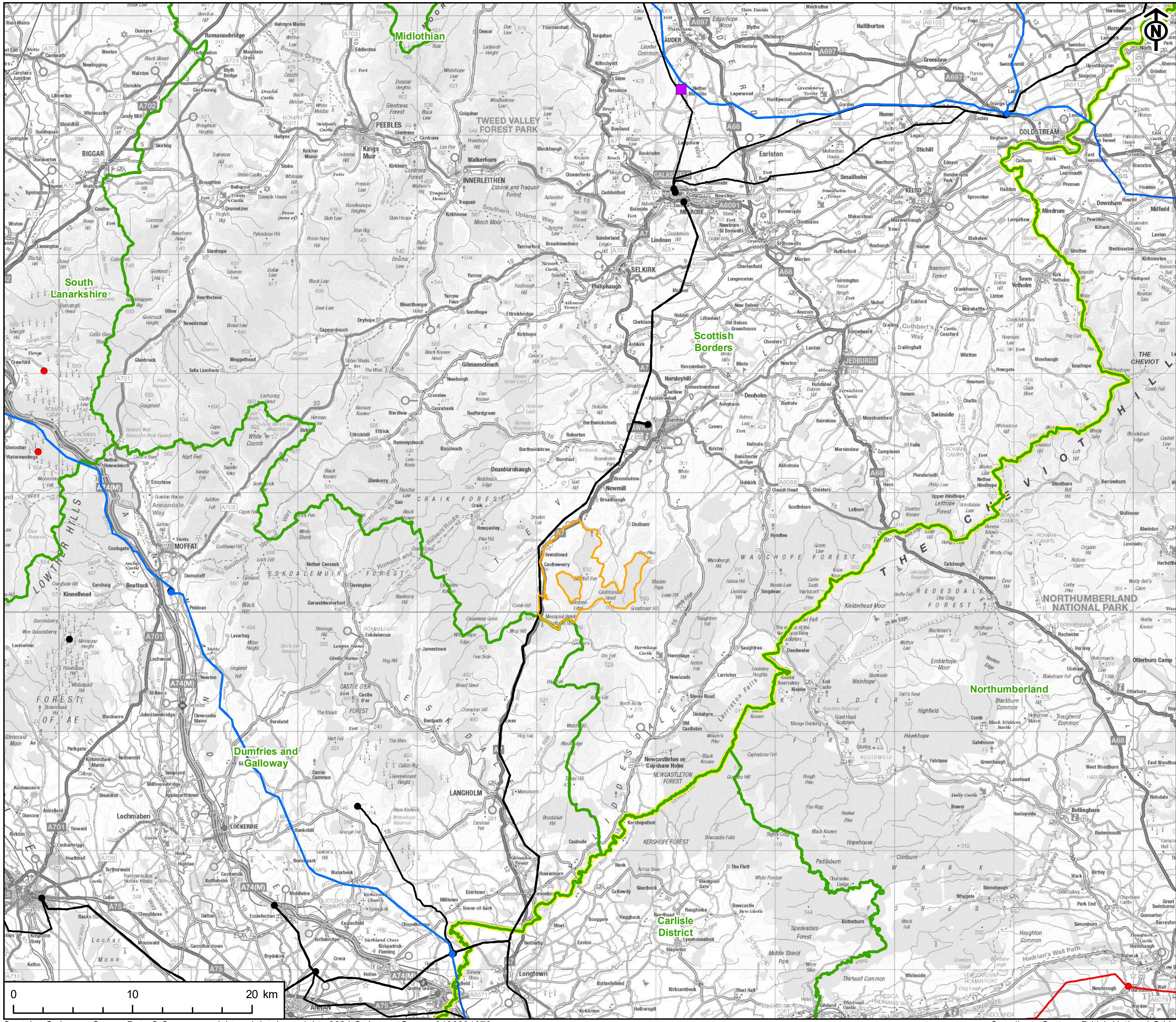
The structure of the document is set out below in Table 1. It describes the approach taken to identifying and assessing alternative route and site options in a clear, systematic manner in accordance with SP Transmission's statutory duties and licence obligations and taking into account industry-recognised approaches to the routeing of OHLs and siting of substations.

Table 1 Routeing and Siting Consultation Document Structure

Section	Description of Content
1. Introduction	Provides an introduction to the Project and an overview of why it is needed, SP Transmission's statutory obligations and an outline of the purpose and structure of the RCD.
2. Description of the Project	Provides an overview of the SP Energy Networks Project and the key physical components which it comprises including details of construction requirements.
3. Approach to Routeing and Siting	Describes SP Energy Network's general approach to routeing and siting of new electricity transmission infrastructure following established practices and sets out the approach to the Project in Scotland.
4. The Study Area	Identifies and describes the Study Area in which the routeing and siting study is undertaken as well as key constraints or features within it.
5. Routeing and Siting Strategy	Describes the Routeing Strategy applied specifically to the SP Energy Networks Project and the key routeing and siting considerations present within the Study Area.
6. Substation Siting	Describes the identification and assessment of alternative substation sites considered for the new Teviot Substation in the vicinity of the proposed Teviot Wind Farm.
7. Strategic Routeing – Route Corridors	Describes the identification and assessment of alternative route corridors between the proposed Gala North Substation, potential Teviot Substation sites and the Scotland-England border.

Section	Description of Content
8. Detailed Routeing – Route Options	Describes the identification and assessment of alternative route options within shortlisted corridors between Gala North, shortlisted Teviot Substation sites and the Scotland-England border.
9. The Preferred Option	Describes the end-to-end options for the SP Energy Networks Project based on alternative substation sites and route options and identifies a Preferred Option and the reasons for its selection.
10. Consultation and Next Steps	Provides an outline of the Phase 1 consultation activities being undertaken and how to provide feedback as well as the next steps in the development and consenting of the SP Energy Networks Project.

Project Management Initials: DR Designer: LC Checked: DF Approved: DR



Scale @ A3 1:300,000

Coordinate System: British National Grid

AECOM

PROJECT
Cross Border Connection - Gala North Substation to Border

CLIENT
SP Energy Networks

KEY
- Proposed Gala North Substation Location
- Proposed Teviot Wind Farm Boundary
- Local Authority Boundary
- Scotland / England Border

Existing Transmission System
- 132 kV Substation
- 275 kV Substation
- 400 kV Substation
- 132kV OHL
- 275kV OHL
- 400kV OHL

TITLE
Figure 1
Overview of the Project

REFERENCE
GH_20240821_RS_1_v2

SHEET NUMBER	DATE
1 of 1	21/08/24

02.
Project Description

2. Project Description

2.1 Introduction

This section provides an overview of the infrastructure which would be required for the SP Energy Networks Project. As described in the previous section, the SP Energy Networks Project will comprise a new double circuit 400kV OHL from the proposed Gala North Substation[14] to a point on the Scotland-England border via a new Teviot Substation. At the border, the OHL will cross into NGET's licence area where they will be responsible for the onwards OHL route to a final connection point in the northwest of England.

It should be noted that given the early stage in the Project's development, the information contained in this chapter is not confirmation of a final design, however, it is considered appropriate for the purposes of the routeing and siting study and to inform the Phase 1 Consultation. In particular, SP Energy Networks will work with NGET to establish a crossing point of the Scotland-England Border that best balances both TOs statutory duties under the Electricity Act 1989.

2.2 Key Elements of the SP Energy Networks Project

The SP Energy Networks Project comprises the following key elements:

- A new double circuit 400kV OHL carried on steel lattice towers between the proposed Gala North Substation and a new Teviot Substation,
- The new Teviot Substation which will also connect the proposed Teviot and Liddesdale (also referred to as Borders) Wind Farms to the electricity transmission network, and
- A new double circuit 400kV OHL carried on steel lattice towers from the new Teviot Substation to the Scotland-England border.

2.3 The New Overhead Lines

Overview of an OHL

OHLs transmit electricity by conductors (often also referred to as 'wires') which are suspended at a specified height above ground and carried by wood poles or steel lattice towers (also referred to as pylons) which are located at regularly spaced intervals. The conductors can be made of aluminium or steel strands. Most OHLs operating at 132kV and above carry two 3-phase circuits, with one circuit strung on each side of a steel tower as shown in the image in Figure 2. The conductors are strung from insulators which are attached to the cross arms of the towers and prevent the electric current from crossing to the tower. Insulators are made of material with a high resistance to electricity flow, for example glass or porcelain. An earth wire may also be required to provide protection from lightning strikes.

[14] The proposed Gala North Substation is outside of the scope of this study. It will be subject to a separate planning application to Scottish Borders Council under the Town and Country Planning (Scotland) Act 1997. More information about it can be found here: https://www.spenergynetworks.co.uk/pages/gala_north_substation.aspx

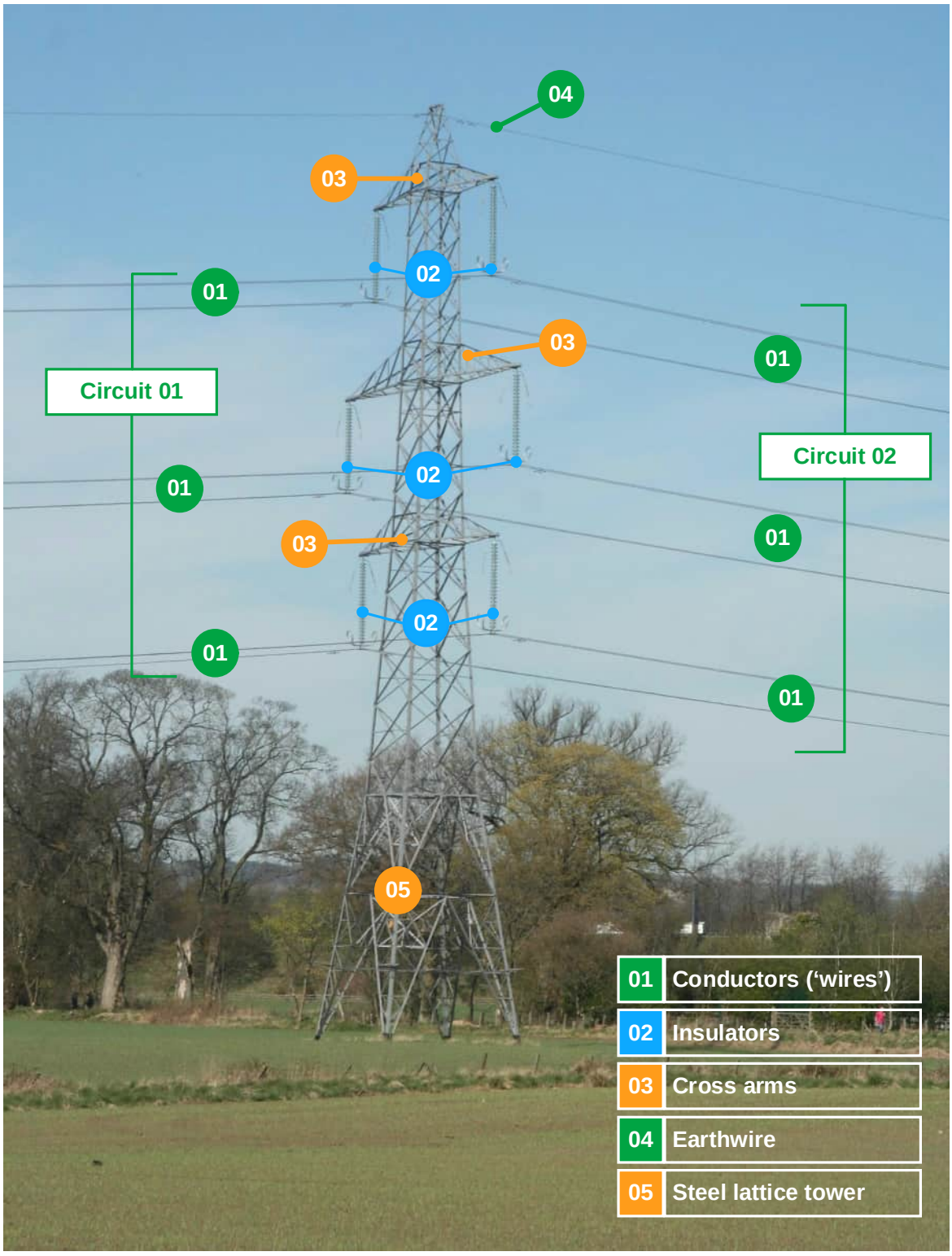


Figure 2 Typical Operational 400kV Double Circuit OHL

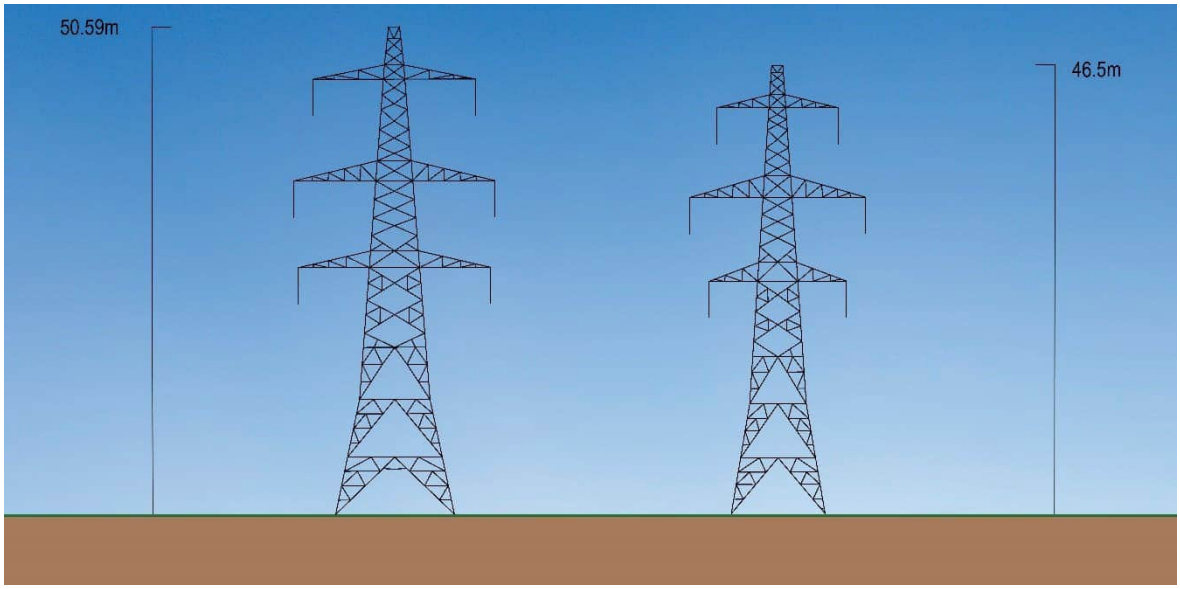
Tower Types, Heights and Span Lengths

The SP Energy Networks Project will be carried on steel lattice towers, however, the precise tower model to be used is subject to detailed design. The height of the steel lattice towers will varies according to the operating voltage of the conductors and relevant electrical safety clearances to the ground. For high voltage overhead lines such as the Cross Border Connection, tower heights would typically range from 46 m to 61m, however, this may increase subject to the route design. In addition to the precise tower model, there are broadly three types of tower which may be required at various points along the new OHL routes subject to detailed design as set out in Table 2.

Table 2 Overhead Line Tower Types

Tower Type	Description
Suspension or Line Tower	These typically form most of an OHL route and are used where the tower is part of a straight-line section of the OHL route.
Tension or Angle Tower	These are used where an OHL route changes direction where there is a horizontal or vertical deviation.
Terminal Tower	These are used when an OHL terminates at a substation or on to an underground cable section via a separate cable sealing end compound or platform.

Figure 3 Typical Overhead Line Tower Designs



The distance between adjacent towers, known as the 'span length', is approximately 300m but this can be increased where there is a requirement to span obstacles or decreased where a route traverses higher altitudes. The exact span distance will depend on site specific constraints or obstacles, however, in general there would typically be 3-4 steel towers per kilometre.

Steel towers are constructed from galvanised steel and typically grey in colour which becomes duller over time (approximately 18 months). The shade of grey is not distinguishable at distance and normally appears as grades of light and dark. Where towers are viewed against the sky, colour cannot be relied upon to diminish visibility, since the lighting characteristics of the sky vary greatly.

Overhead Line – Construction

The construction of OHLs follows a well-established process. As well as the OHL it also requires additional temporary land-take and infrastructure, for example temporary accesses to steel tower locations and temporary construction compounds to store materials. Key phases of construction comprise the following activities:

- Tree felling or lopping (where required) to establish wayleaves or clearances;
- Preparation of temporary construction accesses;
- Excavation of foundations;
- Tower delivery;
- Erection of steel towers;
- Delivery of conductors and stringing equipment;
- Insulator and conductor erection and tensioning; and
- Clearance and reinstatement.

The total duration of construction activity at any single tower site is approximately two weeks for tower foundations, one to two weeks for tower construction, and up to four weeks for conductor erection and stringing depending on the size of the tower and the number of the conductors to be strung. These periods are spread over about four months, with periods of inactivity between, or longer if construction difficulties are experienced elsewhere along the route or ground conditions prevent normal progress.

Prior to constructing the OHL, temporary accesses will be constructed, as necessary, and laydown/storage areas established. Any trees which may impact on safety clearances will be removed or lopped. Following commissioning of the OHL, all equipment and temporary access to construction areas will be removed with the land being reinstated to its former use/condition.

Overhead Line – Operation and Maintenance

OHLs require minimal maintenance. The condition of tower steelwork and foundations is monitored regularly. Periodic painting of the tower steelwork may be required, and components are regularly inspected for corrosion, wear and deterioration. Towers which have deteriorated significantly may be dismantled carefully and replaced. There is also an ongoing requirement to ensure that any vegetation within proximity to the OHL does not impact on safety clearances.

Overhead Line – Decommissioning

The requirement to decommission an OHL depends on a number of factors. At the end of its operational life, if an OHL was required to it could be repaired or refurbished in order to extend its operational life. If an OHL line is to be decommissioned, steel towers will be removed with components re-used where possible. Foundations are removed to a minimum depth of approximately 1m below ground level, the area around the base of the tower is cleared and the ground reinstated.

2.4 The New Teviot Substation

Overview

Substations play a key role in the electricity transmission system. They help to manage and control electricity flows as well as (1) connecting generators such as wind farms and/or (2) connecting to the electricity distribution network at grid supply points (GSPs). They transform the voltage of electricity from high to low ratings or vice versa (also referred to as stepping up or stepping down the voltage). For example, generators such as wind farms may connect at a substation and the voltage be increased or stepped up for onwards transmission or reduced so that it distributed to homes and businesses. Substations are also key in helping to isolate and fix faults and allow maintenance to be carried out safely on the electricity network. In the case of the new Teviot Substation it will facilitate connection of new renewable wind generation to the electricity network.

Substation Technology

There are broadly two main types of substation; those which use Air Insulated Switchgear (AIS) and those which use Gas Insulated Switchgear (GIS). AIS substations use air as the insultation medium for electrical equipment. Equipment is predominantly located outdoors requiring a larger footprint to ensure the necessary safety clearance areas between equipment. In GIS substations some equipment including switchgear can be located within buildings as it uses gas as the insultation medium. This enables safety clearance areas to be reduced meaning that the footprint of a GIS substation is therefore smaller than that of an equivalent AIS substation. For all of its new substations, SP Energy Networks evaluates the merit of both AIS and GIS technology. This includes but is not limited to consideration of environmental impacts, land availability, technical considerations such as required switchgear rating and the economics of each option.

Figure 4 Typical AIS and GIS Substations

03.

Approach to Routeing and Siting

3. Approach to Routeing and Siting

3.1 SP Energy Networks' Approach to Routeing

Overview

In 2015, as part of a wider industry review involving the UK and Scottish Governments as well as the Office of Gas and Electricity Markets (Ofgem), SP Energy Networks (acting on behalf of SP Transmission) reviewed its approach to routeing of new overhead lines. This review concluded that the requirement to balance statutory duties and licence obligations comprising economic, technical and environmental factors continues to support the development of an OHL in most circumstances. However, SP Energy Networks also concluded that there are certain circumstances in which development of an underground cable (UGC) should be considered.

A further review of the approach was undertaken in 2020 as part of preparing SP Transmission's RIIO-T2[15] Business Plan which reaffirmed these conclusions. As part of the review SP Energy Networks consulted on and published an updated version of '*Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment*'[16] which describes their general approach to the routeing and siting of new electricity transmission infrastructure.

The basic premise of SP Energy Network's approach is that the main effect of an OHL is visual and that the degree of visual impact can be reduced by careful route selection; for example by using topography and trees to provide screening and/or background to the OHL and by routeing the OHL at a distance from settlements and roads. In addition, OHL routeing takes into account other environmental and technical considerations and will avoid, wherever possible, the most sensitive and valued natural and man-made sites, areas or features.

Routeing Considerations

In line with SP Transmission's statutory duties and licence obligations and drawing upon established practice, routeing considerations comprise environmental, technical and economic factors. The routeing considerations inform the identification and assessment of route options ensuring that it is robust and transparent.

- Environmental factors: route options must take account of their potential environmental impact. Following SP Transmission's statutory obligations this is interpreted as seeking to preserve features of natural and cultural heritage interest and to mitigate as far as possible any effects route options may have on such features as well as more widely

[15] RIIO-T2 is the current price control and runs from April 2021 to March 2026. RIIO stands for 'Revenue = Incentives + Innovation + Outputs'. It's a framework used by Ofgem to ensure that network companies, like SP Transmission, provide a safe and reliable service, value for money, maximise performance, operate efficiently, innovate and ensure the resilience of their networks for current and future customers.
[16] Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment: https://www.spenergynetworks.co.uk/userfiles/file/SPEN_Approach_to_Routeing_Document_2nd_version.pdf

taking account of potential impact of route options on the environment and people including on:

- Landscape including landscape designations and landscape character;
- Visual amenity;
- Biodiversity including ecology and ornithology;
- Cultural heritage including archaeology;
- Forestry and woodland including ancient and native woodland;
- Water resources and ground conditions such as peat;
- Land use; and
- Tourism and recreation.

- Technical factors: route options must be technically feasible. This is interpreted by SP Energy Networks as it must be possible to build, operate and maintain route options. Technical considerations include matters which would affect these aspects for example existing electricity transmission or distribution infrastructure, topography, side slope gradients, altitude, ground conditions and accessibility as well as proximity to wind farms.
- Economic factors: route options must be economically viable. This is interpreted by SP Energy Networks as meaning that as far as is reasonably practicable, and all other routeing considerations being equal, route options should be as direct as possible and should avoid areas where technical constraints would render route options unviable on economic grounds.

3.2 Established Practice for Overhead Line Routeing

Overview of the Holford Rules

In 1959, Lord Holford, then advisor to the Central Electricity Generating Board (CEGB), developed a series of guidelines regarding the routeing of high voltage OHLs which have subsequently become known as the "Holford Rules" ('the Rules'). It is generally accepted across the industry that the Rules should continue to inform the routeing of high voltage OHLs. The Rules were reviewed in the early 1990s by the then National Grid Company (NGC) Plc. (now NGET) with notes of clarification added to update them and reflect up to date circumstances. A subsequent review of the Rules including the NGC clarification notes was undertaken by Scottish Hydro Electric Transmission Limited (SHETL) (now SSEN Transmission) in 2003 to reflect Scottish circumstances. A copy of the Rules as well including notes added through subsequent reviews by NGC, SHETL and most recently by SP Energy Networks is contained in Appendix A.

SP Energy Networks' general approach draws on the Rules including avoidance of areas of highest or high amenity value where possible as well as consideration of landform, topography and vegetation in order to reduce landscape and visual effects.

Interpretation and Application of the Holford Rules to the SP Energy Networks Project

Routeing considerations take account of the guidance contained in the Holford Rules and relevant notes or clarifications. In identifying routeing considerations which are relevant to the SP Energy Networks Project and Study Area (defined in section 4), the Rules and relevant notes or clarifications have been interpreted and applied to this routeing and siting study.

The Rules are broadly hierarchical with Rules 1 and 2 placing considerable emphasis on avoiding areas of the highest or high amenity value. Rule 1 advises that routes should avoid major areas of the highest amenity value where possible and Rule 2 that routes should avoid smaller areas of high amenity value by deviation. The term "*amenity*" has generally been interpreted as designated areas or sites of scenic, landscape, nature conservation, scientific, architectural or historical interest. This is consistent with SP Transmission's duties under Schedule 9 to the Electricity Act 1989. For the purposes of this routeing and siting study, the term 'amenity' has been replaced by 'environmental' to more appropriately reflect the intrinsic environmental, social and cultural value of such designated areas.

The review undertaken by SHETL in 2003 provides examples of areas of the "*highest*" or "*high*" amenity or environmental value and states that such areas "require to be established on a project-by-project basis considering Schedule 9 of the Electricity Act 1989". For the purpose of this routeing and siting study, such areas are considered to include international and national designations such as sites designated for landscape, nature, built heritage or archaeological conservation reasons.

The Rules do not identify what constitutes "*major areas*" or "*smaller areas*" but indicate that consideration should also be given to the spatial extent of areas of highest or high amenity or environmental value. Value is not considered to be related to the size of an area, so for the purposes of this routeing and siting study this has been interpreted as the extent to which areas of the highest or high amenity or environmental value are avoidable by careful route and/or site selection.

The notes and clarifications provide guidance with regard to areas of moderate or low amenity or environmental value noting that regional or local areas or sites should be identified from development plans. For the purposes of this routeing and siting study this includes locally designated landscapes, local wildlife sites or reserves, undesignated woodland and outdoor recreational areas such as country parks.

While the Rules do not address residential areas, the supplementary notes and clarifications provide guidance stating "*avoid routeing close to residential areas as far as possible on grounds of general amenity*" and "*in rural areas avoid as far as possible dominating isolated house, farms or other small-scale settlements*". For the purposes of this routeing and siting study, settlements have been defined as areas of high amenity or environmental value. Smaller clusters of properties or individual properties are considered to be a deviation issue and while they are of similar importance to settlements they are a detailed routeing consideration that may be more appropriately addressed through the identification of a detailed route alignment in subsequent stages of developing the SP Energy Networks Project.

Rules 3, 4, 5 and 6 highlight the importance of considering landscape and visual matters in routeing including giving consideration to landscape character including sensitivity to OHLs, the use of landform and woodland to reduce visual intrusion or prevent skylining and the

presence of other OHLs and the potential to create 'wirescapes'. For the purposes of this study, landscape and visual considerations have informed the identification of route options taking account of other routeing and siting considerations described above as far as possible.

Specific technical or economic considerations are not identified in the Rules or notes and clarifications, however, these form part of SP Transmission's statutory duties. For the purposes of this study this includes the directness of route options (i.e. subject to other routeing considerations route options should be as direct as possible) as well as matters affecting SP Energy Networks's ability to build, operate and maintain an OHL within the route options identified, for example taking account of existing electricity transmission or distribution infrastructure, topography, side slope gradients, altitude, ground conditions and accessibility.

Forestry Guidelines

SP Energy Networks' '*Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment*' provides guidance with respect to routeing and forestry. While it is generally preferable to avoid forestry and woodland (in particular ancient and/or native woodland), in some cases this may not be possible. Where routeing is required through forested areas key considerations relate to reducing landscape and forestry impacts while also taking account of safety standards and forestry design guidelines including those set out in Scottish Forestry guidance '*Design techniques for forest management planning: practice guide*'.

3.3 Established Practice for Substation Siting

Overview of the Horlock Rules

The Horlock Rules were devised in 2003 and updated in 2006 by National Grid Company (NGC) plc. They contain guidelines to inform the siting and design of substations with the objective of mitigating the environmental effects of such developments as far as reasonably possible. They are widely used within the industry to inform the siting of substations and other similar electricity network infrastructure such as converter stations. A copy of the Horlock Rules is contained in Appendix B.

Interpretation and Application of the Horlock Rules to the Project

The guidelines cover a range of aspects promoting consideration of the potential environmental effects from the earliest stages of site selection through to design. Similar to the Holford Rules they set out a broadly hierarchical approach:

- Promoting avoidance of sites of amenity, cultural or scientific value (including international, national and local sites) in site selection. As above for the purposes of this study this is interpreted as avoiding sites of environmental value.
- Taking account of local context such as existing features such as landform or woodland to screen sites and reduce intrusion into surrounding areas as much as possible.
- Careful consideration of substation design including the size of building or other structures as well as consideration of colours and materials in order to integrate with surrounding development or features.

3.4 Approach to the SP Energy Networks Project

Overview

The approach to identifying and assessing alternative route and site options for the SP Energy Networks Project is illustrated below in Figure 5. It follows SP Energy Networks approach and draws upon established practice ensuring that it is robust and as transparent as possible. It is a systematic and iterative approach in which an increasing level of detail is applied at each step concluding with the identification of a Preferred Option to be subject to consultation. The outcome of each step is subject to a technical review and, where relevant, consultation with key stakeholders. Professional judgement is used to establish a balance between technical, economic viability and environmental factors influencing route and site options. It should be noted that while the process is illustrated sequentially the interdependencies of the SP Energy Networks Project's components and the influence that they have over each other (i.e. substation site selection informing route selection and vice versa) means that there is a necessary degree of overlap and iteration in the identification and assessment of route and site options.

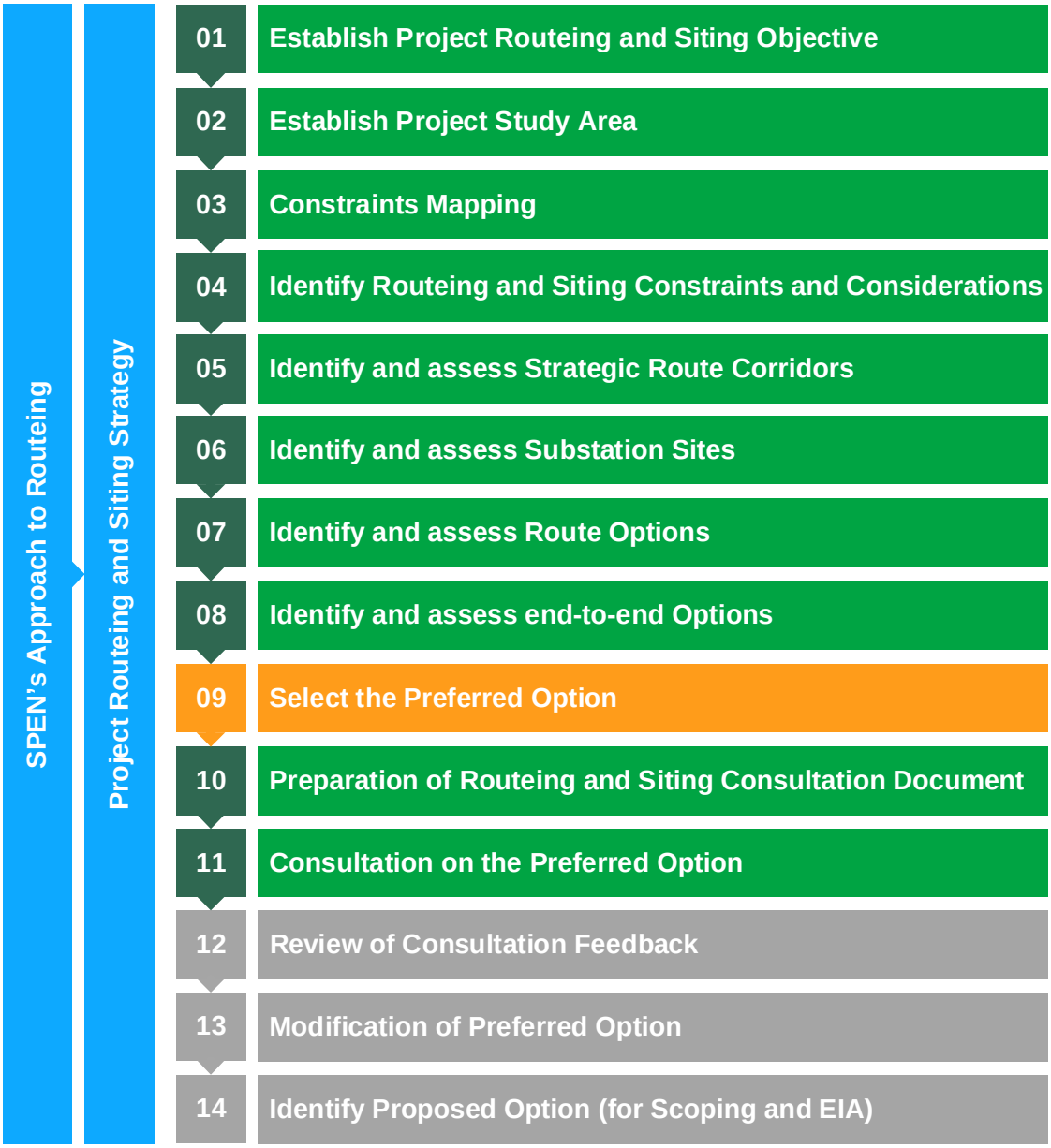


Figure 5 Approach to the Routeing and Siting Study

There are broadly three key activities with a series of steps within them:

- Firstly informed by Steps 1 to 4, the definition of a routeing and siting strategy specific to the SP Energy Networks Project that responds to the study area and key routeing constraints and considerations contained within it.
- Secondly in Steps 5 to 9, the application of the routeing and siting strategy to identify and assess substation site options, route corridors and route options within them concluding with identification of a complete or end to end Preferred Option.
- Finally, consultation on the Preferred Option through Steps 10 to 13 with feedback received being used to modify the Preferred Option where appropriate and inform the identification of a Proposed Option to take forward to subsequent stages.

Project Routeing and Siting Objective

The first step in the approach has been to identify a routeing objective which takes account of SP Transmission's statutory duties and licence obligations. In accordance with SP Energy Networks' overall approach to routeing, the routeing and siting objective for the SP Energy Networks Project is set out below:

"To identify a technically feasible and economically viable 400kV overhead line route between the proposed Gala North Substation and the Scotland-England border via a new Teviot Substation which causes, on balance, least disturbance to the environment of the Study Area and the people who live, work and enjoy recreation within it."

Establishment of a Study Area and Constraints Mapping

A constraints mapping exercise was undertaken to identify relevant environmental, technical and other constraints within the study area and inform the identification of routeing considerations. This includes environmental constraints such as area or sites designated for landscape, ecological or cultural heritage reasons, settlement including towns, villages and individual properties, physical environmental constraints such as ground conditions or waterbodies, land use or planning considerations including planning allocations or local designations as well as technical constraints including topography, other electricity network infrastructure and wind farms. Table 3 provides an overview of the constraints information collated and reviewed to inform the routeing and siting study. It should be noted that some constraint information relating to environmental constraints south of the Scotland-England Border has been collated and taken into account in so far as it may influence the identification of route options to the Scotland-England Border, however, detailed analysis of those constraints will be undertaken by NGET as part of its own routeing and siting studies.

Table 3 Constraints Mapping Information

Topic/sub-topic	Routeing and Siting Constraints or Considerations	Key Dataset Sources
Landscape	National Scenic Areas, Wildland Areas, Special Landscape Areas, Regional Scenic Areas, landscape character and Gardens and Designed Landscapes	• NatureScot Spatial Data Hub • Scottish Borders Local Development Plan • Dumfries and Galloway Local Development Plan • Historic Environment Scotland Download Portal
Ecology and Ornithology	Special Protections Areas (SPAs), Special Areas of Conservation (SACs), Ramsar sites and Sites of Special Scientific Interest (SSSIs), Scottish Wildlife Trust Reserves and Local Wildlife Sites	• NatureScot Spatial Data Hub • Scottish Borders Local Development Plan • Dumfries and Galloway Local Development Plan

Topic/sub-topic	Routeing and Siting Constraints or Considerations	Key Dataset Sources
Cultural Heritage and Archaeology	Scheduled Monuments, Inventory Battlefields, Listed Buildings, Gardens and Designed Landscapes, Conservation Areas and non-designated archaeology	• Historic Environment Scotland Download Portal • PastMap • Scottish Borders Local Development Plan • Dumfries and Galloway Local Development Plan
Settlements	Towns, villages and other residential dwellings including scattered rural properties	• Ordnance Survey mapping and date (Address Base) • Aerial Imagery
Tourism and Recreation	Country Parks, Regional Parks, long distance walking routes, Core Paths and other formal/informal open space or amenity areas	• Ordnance Survey mapping • NatureScot Spatial Data Hub • Scottish Borders Council • Dumfries and Galloway Council • Visit Scotland
Land use	Notable land uses including agricultural land and other major development including notable planning applications	• National Map – Land Capability for Agriculture • Scottish Borders Council • Dumfries and Galloway Council
Trees and Woodland	Sites identified on Ancient Woodland Inventory (AWI) or by the Native Woodland Survey of Scotland (NWSS) and commercial forestry	• NatureScot Spatial Data Hub • Scottish Forestry data
Water Environment	Flood risk areas and major waterbodies	• SEPA Flood maps • SEPA Water Environment Hub
Ground Conditions	Geological conservation review sites, carbon rich soils and peatland	• NatureScot Spatial Data Hub • Carbon and Peatland Map • British Geological Survey Online Viewer
Other infrastructure	Other infrastructure including roads and railway lines as well as wind farms (existing and proposed), existing transmission and distribution overhead lines and gas pipelines	• Ordnance Survey mapping • SP Transmission data (existing 132, 275 and 400kV network) • NGET data (existing 275 and 400kV network) • Energy Consents Unit • Scottish Borders Council

Topic/sub-topic	Routeing and Siting Constraints or Considerations	Key Dataset Sources
		• Dumfries and Galloway Council
Topography and landform	Slope, gradient and elevation/altitude	• Ordnance Survey data

Identification of OHL Routes

Given the scale of the SP Energy Networks Project a two-stage approach has been taken to the identification of OHL routes, firstly the identification of strategic corridors and secondly the identification of route options.

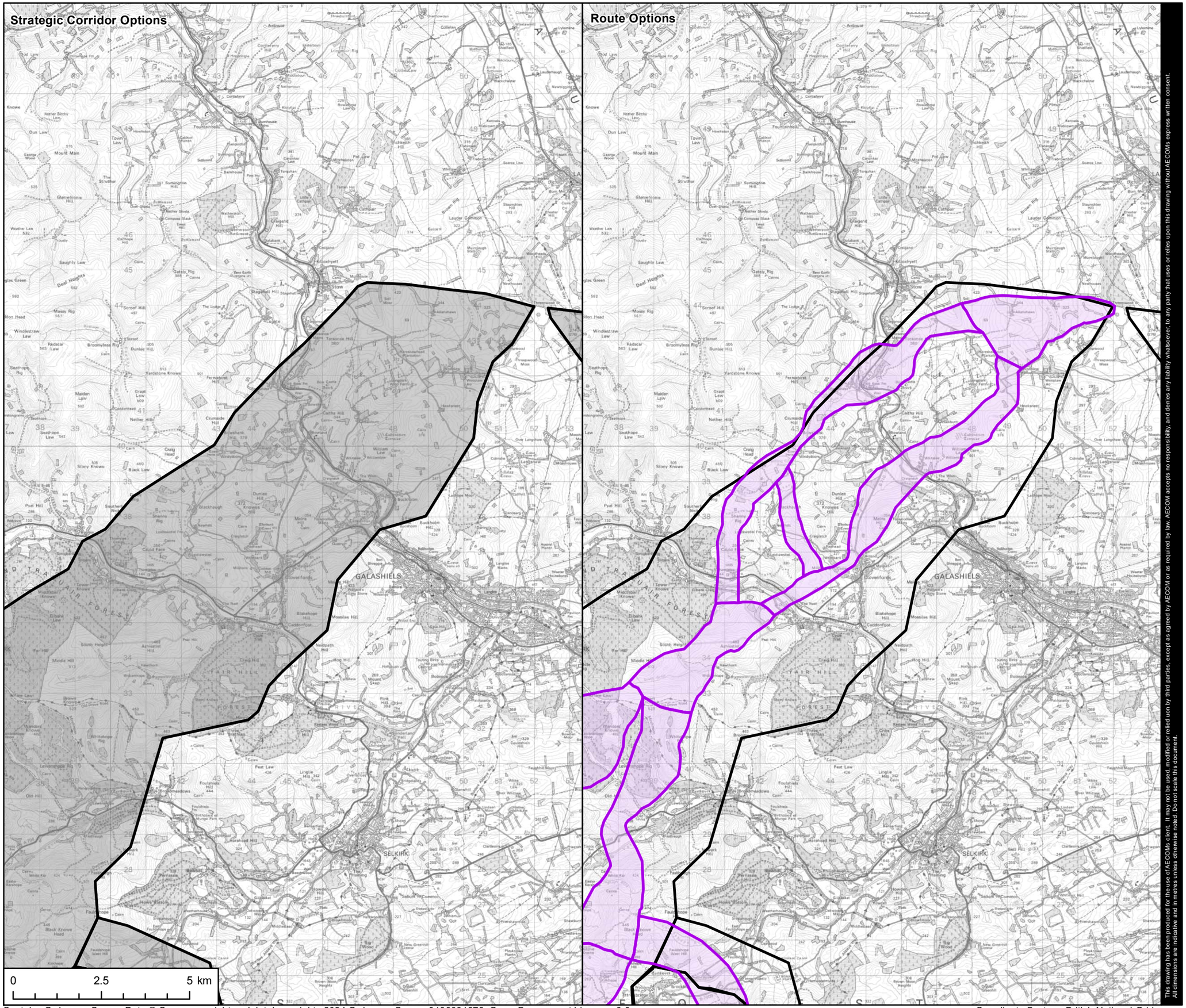
Strategic route corridors are typically wider having been identified taking account of a narrower range of routeing considerations including larger sites or areas of the highest or high environmental value such as designated sites and settlements as well as landscape and landform. This approach helps to focus development of route options within areas in which OHL routeing is considered most feasible and also allows for routeing work to be undertaken in parallel with substation siting.

Based on the appraisal of strategic route corridors, shortlisted route corridors have been taken forward for further development either refining them into route options or developing route options within them in response to more detailed or localising routeing considerations. Figure 6 provides a visual comparison of strategic route corridors and route options.

Identification of Substation Sites

The identification of potential substation sites has been informed by the basic technical requirements. While the substation itself would have an operational footprint of approximately 4ha, additional land would be required during construction such as for site offices, storage and laydown areas while subject to site specific characteristics additional land could be required for environmental mitigation. The basic operational footprint has been used as a starting point for the identification of potential sites.

Project Management Initials: DR Designer: LC Checked: DF Approved: DR



Scale @ A3 1:100,000

Coordinate System: British National Grid

AECOM

PROJECT
Cross Border Connection -
Gala North Substation to Border

CLIENT
SP Energy Networks

KEY
- Strategic Route Corridor
- Route Option

TITLE
Figure 6
Visual Comparison of Strategic Route Corridors versus Route Options

REFERENCE
GH_20240822_RS_6_v1

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1 of 1

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22/08/24