Carrick 275kV Substation

NESO Driven EJP
Version: 1.0
11/12/2024

SP Energy Networks
RIIO-T3 Business Plan

SP Energy Networks

Name of Scheme	SPT-RI-293 Carrick 275 kV Substation		
Investment Driver	Local Enabling (Entry)		
BPDT / Scheme Reference Number	SPT200269		
NESO Review	NESO Reviewed: No		
Outputs	• 275 kV Feeder - 4 units • 275/33 kV 90 MVA transformer – 2 units • 33 kV indoor switchgear for metering purposes • 33 kV circuit breakers on WF side – 4 units • All protection, communication, SCADA and control associated with the Carrick and Knockcronal Wind Farms.		
Cost	£13.78m		
Delivery Year	2029		
Applicable Reporting Tables	BPDT (Project_Meta_Data, Scheme_C&V_Calc_NonLoad_Actuals)		
Historic Funding Interactions	N/A		
Interactive Projects	N/A		
Spend Apportionment	**ET2**	**ET3**	**ET4**
	£3.18m	£10.60m	£0.00m

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1. Introduction

This engineering justification paper describes SP Transmission's plans to establish a new 275 kV substation at Carrick between Coylton and Mark Hill 275 kV substations on YY Route to allow the connection of the 84 MW Carrick Wind Farm and 59.4 MW Knockcronal Windfarm to the SP Transmission plc (SPT) network.

This Engineering Justification Paper (EJP) is submitted for Ofgem's assessment of the need case for the project in order to provide sufficient funding for the pre-construction activities. A full optioneering cost submission will be made at the appropriate time, once the project is sufficiently developed to do so.

2. Background and Purpose

SPT, as a transmission license holder, has the responsibility "to develop and maintain an efficient, co-ordinated and economical system of electricity transmission" (Electricity Act 1989).

In the context of both UK and Scottish Government Net Zero targets, now supported fully by National Planning Framework for Scotland 4 (NPF4), development of our transmission infrastructure is key to meeting these targets, with SPT required to deliver significant system reinforcement as well as facilitating the connection of increased renewable energy generation. An upgraded transmission grid allows greater flexibility in accommodating new low carbon sources of energy – such as the [redacted].

The purpose of this document is to set out the broader policy context and needs case for a new 275 kV substation to be installed to allow connection of [redacted].

2.1. Statutory Obligations

SPT is licenced under section 6(1)(b) of the Electricity Act 1989 ("the 1989 Act") to transmit electricity. The licence is granted subject to certain standard and special conditions. Under section 9(2) of the 1989 Act, SPT is required to fulfil the following duty:

- *To develop and maintain an efficient, co-ordinated and economical system of electricity transmission; and*
- *To facilitate competition in the supply and generation of electricity.*

This statutory duty is reflected in SPT's transmission licence. In addition, SPT has the following obligations pursuant to its licence conditions (LCs):

- To at all times have in force a System Operator-Transmission Owner Code (STC) which, amongst other things, provides for the co-ordination of the planning of the transmission system (LC B12);
- To at all times plan and develop its transmission system in accordance with the National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS) and in so doing take account of National Energy System Operator's (NESO's) obligations to co-ordinate and direct the flow of electricity on, to and over the GB transmission system (LC D3);
- To make available those parts of its transmission system which are intended for the purposes of conveying, or affecting the flow of, electricity so that such parts are capable of doing so and are fit for those purposes (LC D2); and

- To offer to enter into an agreement with the system operator on notification of receipt of an application for connection, or for modification to an existing connection (LC D4A).

Section 9 and Schedule 38 of the 1989 Act also impose duties on SPT when formulating any relevant proposals. In response to statutory and licence obligations upon it, SPT therefore requires to ensure that the transmission system is developed and maintained in an economic, co-ordinated and efficient manner, in the interests of existing and future electricity consumers, balancing technical, economic and environmental factors.

2.2. Broader Policy Context

Government Policy

In June 2019, the UK parliament passed legislation introducing a binding target to reach Net Zero greenhouse gas emissions by 2050. In Scotland, the Scottish Parliament has committed Scotland to becoming a Net Zero society by 2045. The timely connection of low carbon generation, such as onshore and offshore wind, will play a vital role in reaching these legislated Net Zero targets.

The UK Government announced in October 2020 its commitment to make the UK a world leader in green energy and boosted the UK Government's previous 30 GW target for offshore wind to 40 GW by 2030. The current Scottish Government ambition, published in the Onshore Wind Policy Statement[1], is 20 GW of onshore wind in addition to the 11 GW of offshore wind in Scotland by 2030.

Further commitments by the UK Government in October 2021 to decarbonise the power system by 2035, as well as the British Energy Security Strategy[2] published April 2022 (which raises the UK Government ambition to 50 GW of offshore wind by 2030) further support the requirement for investment in the existing electricity transmission system to enable the timely connection and integration of the required renewable generation sources.

2.3. YY Route Evolution

The proposed Carrick substation is set to be connected to the existing YY route between Mark Hill and Coylton 275 kV substations approximately 25 km from Mark Hill. YY route is the Auchencrosh – Mark Hill – Coylton 275kV single circuit and forms part of SPEN's 275 kV network on the west coast of Scotland.

The YY route is currently a three-ended single circuit connecting the Moyle HVDC Interconnector at Auchencrosh to Coylton 275kV substation with a tee to Mark Hill substation. Protection on the YY route includes single-phase high-speed auto reclosing to provide an uninterrupted connection to the Moyle Interconnector in the event of a single-phase fault on the circuit.

The YY route is composed of overhead line with single Curlew HTLS conductor, which has a summer pre-fault rating of 890 MVA. At present there is 1983 MW of generation connected contracted, or offered on that circuit, which includes 500 MW import from Ireland on the Moyle Interconnector.

Table 1 presents all the connected and contracted generation assets on YY route at the time of writing.

[1] Onshore wind: policy statement 2022 - gov.scot (www.gov.scot)
[2] British energy security strategy - GOV.UK (www.gov.uk)

Table 1: Connected and Contracted generation along the YY route.

Asset	Capacity (MW)	Status
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
[redacted]		
Total:	**1983**	

2.4. Beyond 2030 Publication

Building upon NESO's Network Options Assessment (NOA) 2021/22 Refresh report[3] the recent publication of NESO's "Beyond 2030" report[4] outlines a requirement for further significant network reinforcements to the value of approximately £58bn across Britain.

The report's recommendations will facilitate the connection of an additional 21 GW of low carbon generation to the UK transmission system as a direct result of the ScotWind leasing round and will help the UK meet its decarbonisation ambitions.

The Beyond 2030 report sets out the output of a holistic network design exercise undertaken by the NESO and TOs which assessed various permutations of onshore and offshore network reinforcement against an agreed set of design criteria[5]. One of the key areas identified for onshore reinforcement within the report is central and southern Scotland where a coordinated suite of onshore reinforcement has been identified to complement the proposed offshore network and provide a significant increase to the transfer capability of key system boundaries including B6. The Carrick and Knockcronal WFs lie within this region of Scotland.

2.5. Existing System and Relevant Proposed Upgrades

The southwestern part of Ayrshire already has an established transmission network. In Figure 1, blue lines represent 400 kV routes and red lines represent 275 kV routes. Carrick 275 kV Substation is set to be located approximately 25 km northeast of the existing Mark Hill 275 kV substation.

The wider system is set to be managed through the proposed NESO Open Balancing Programme (OBP). The current rate of new generation connecting means that the needs case for securing this area of the network is now aligned with the roadmap and timescales of the OBP delivery schedule.

[3] Subject reinforcement recommended to Proceed within NOA 2021/22 Refresh see option ref CMNC within download (nationalgrideso.com)
[4] nationalgrideso.com/document/304756/download
[5] Further detailed provided within NESO's Beyond 2030 Technical Report Final Strategic Options Appraisal (nationalgrideso.com)

Overloads in these areas are to be managed by the OBP scheme to provide the following functionality to help manage generation in Southwest Scotland:

• A Category 2 operational intertripping scheme to manage flows across Kilmarnock South SGTs when one or more SGTs are unavailable.

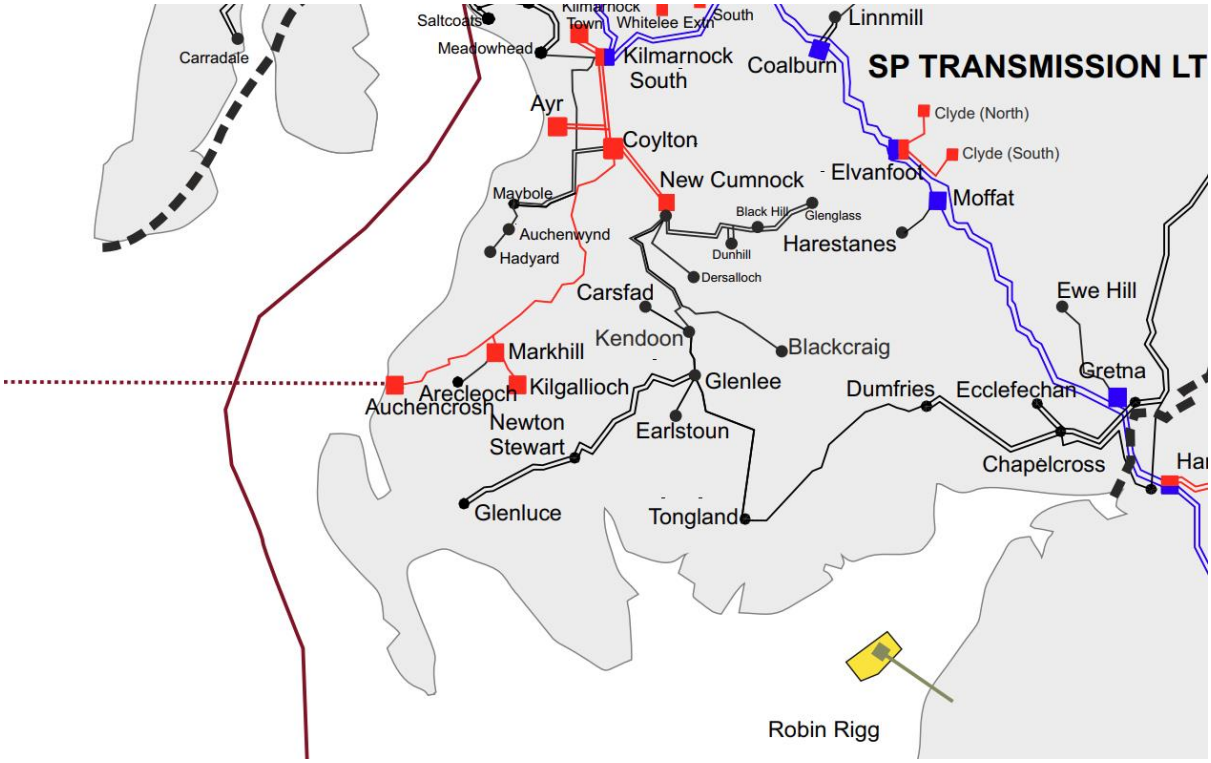

Figure 1: Existing Geographical Transmission Network in southern Ayrshire - Extracted from Electricity Ten Year Statement (ETYS) Appendix A

Figure 2 presents the existing transmission system in the area local to Carrick at the time of writing.

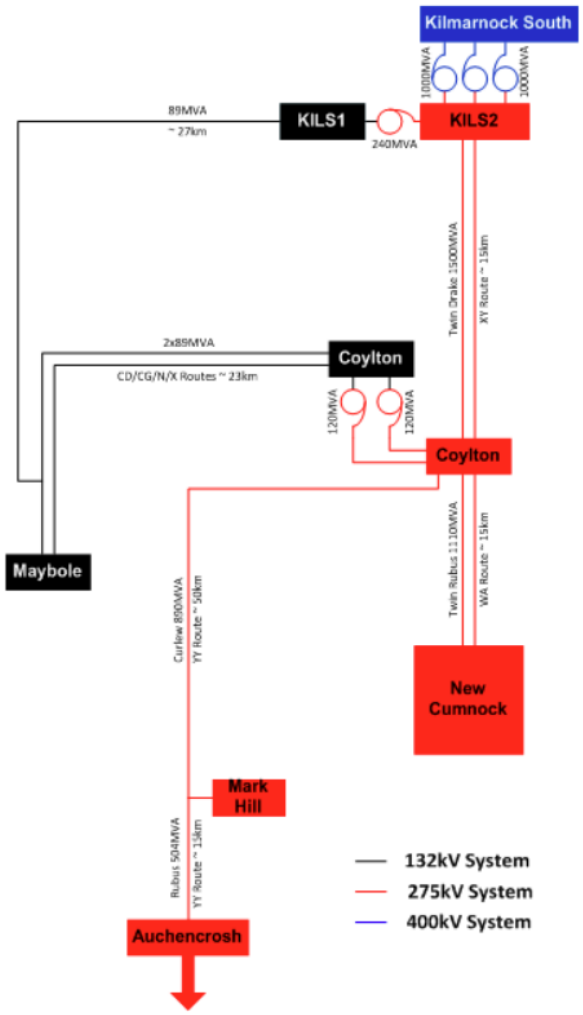

Figure 2: Southern Ayrshire transmission network schematic.

2.6. New Connections

Due to the heavily loaded nature of the network in this region, in order for [redacted] to connect to SPT, network reinforcements must be carried out.

At this stage there is currently 143.4 MW of contracted generation to be added to the network around this region, all of which feature within the SPT Best View based on TECA analysis (described below). Details of all the relevant projects to be connected at the Carrick 275 kV substation are listed in Table 2.

Connecting Substation	Contracted Development	Consent Status	TECA Score[6]	Contracted Energisation Date	SPT-RI-293
[redacted]					
Total Capacity (MW)		-	-	-	**143.4 MW**

Table 2: Contracted Generation dependant on SPT-RI-293

During the process of identifying and evaluating options for each connection offer, due regard was 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 vs steel tower, connection voltage etc).

As a part of the RIIO-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, 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. Areas that have a significant 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.

The methodology of the scoring system splits the overall score into 4 separate categories, each of which carry a different weight regarding the final score and which take into account aspects that are specific to individual projects and the technology as a whole. The four categories are as follows:

[6] *Transmission Economic Connections Assessment (TECA) – This assessment represents SPT's best view of the contracted generation background to 2036 and to evaluate timely delivery of reinforcement works. This regular assessment activity provides updated projections of renewable development in Scotland, and feeds into SPT's plans, ensuring the investment best meets the needs of users and customers.*

- Technology
- Technology Maturity
- Developer Track Record
- Planning Status

The data presented indicates that there is sufficient confidence that the majority of projects directly affected by the works of SPT-RI-293 will connect to the network, based on those categorised as high and medium probability to progress these works. This would indicate an increase of 143.4 MW being added to the network that are affected by the enabling works of SPT-RI-293.

Given the targets 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 completion of these infrastructure projects will provide the necessary increase in capacity required to support these projects and will ensure continuity of connectivity through providing a robust and stable infrastructure to support the circuit.

3. Optioneering

This section provides a description of the options that were considered to accommodate connection of the [redacted]. A summary of each option is described in Table 4. In addition, the system requirements and design parameters for the considered options are summarised in Table 5. At this stage of the optioneering process only high-level analysis has been conducted. Further work will occur later to develop the stated options into more mature plans. For example: GIS/AIS options appraisal, precise locations of assets, number of bays, etc will all be determined as part of a future work package.

3.1. Baseline: Do Nothing / Deferral

A 'Do Nothing' or 'Delay' option is not credible in relation to this project and would be inconsistent with SPT's statutory duties and licence obligations – these include Licence Conditions D3 and D4A. Such offers being in accordance with the System Operator Transmission Owner Code (STC) and associated Construction Planning Assumptions provided by NESO. The proposed works are identified as Enabling Works in the connection agreements relating to the projects named in Table 2.

3.2. Option 1 – New Carrick 275 kV Single Busbar AIS Substation

This option is to establish a new single busbar 275 kV substation at Carrick – 25 km northeast of the Mark Hill substation in south Ayrshire. This would be achieved by establishing the new Carrick substation between the Coylton and Mark Hill substations – situated along YY route. The new proposed Carrick substation would comprise 4 bays to accommodate both the [redacted].

Figure 3 shows the approximate proposed configuration for connection of the [redacted] under Option 1.

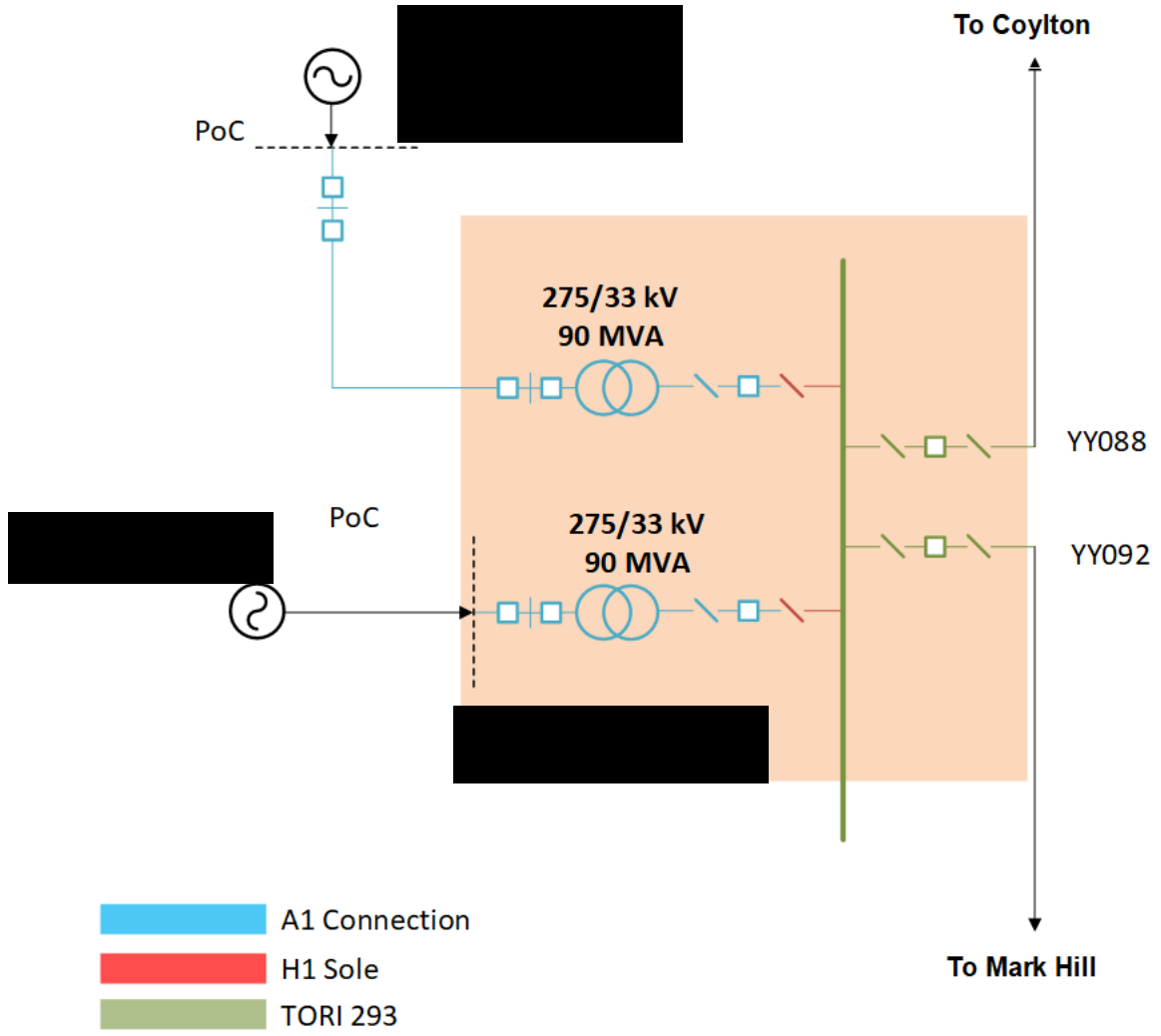

Figure 3: Option 1 proposed configuration.

Implementation of this option would require the following works:

- Construction and installation of the four bay 275 kV single-busbar substation building, consisting of:
    - One 275kV incomer bay for the Coylton OHL (YY088)
    - One 275kV incomer bay for the Mark Hill OHL (YY092)
    - Two 275kV feeder bays for the 275/33 kV SGTs.
- Installation of two 90 MVA transformers to step the voltage down from 275 kV to 33 kV – one transformer for each of: [redacted].
- Installation of two indoor 33 kV metering CBs (and associated line isolators) at the Carrick 275 kV substation – one for [redacted].
- Installation of 33 kV metering switchgear for both the [redacted]. The POC for the Carrick WF will be at the Carrick 275/33 kV substation.
- The POC for the [redacted] will be at the [redacted] which is connected to the Carrick 275/33 kV substation via a 33kV underground cable.

- Installation of a protection scheme at both [redacted] to interface with NESO's OBP.
- Provision of necessary communications and signalling infrastructure to interface with NESO's OBP.
- All associated protection and control works.
- All associated environmental and civil works.
- Miscellaneous works.

However, it is noted that the success of Option 1 is contingent on reinforcement works required as part of the implementation of the OBP being completed as per their expected completion dates of October 2025.

The estimated total cost for this option is £13.78m.

Creation of a new 275 kV substation at Carrick would allow for the connection of the generation developments detailed in Table 2 as well as providing reinforcement and additional capacity in the southern Ayrshire area.

Originally the substation was set to be located on an incline with a 12 m difference in height between the fence lines – causing the predicted total cost to be much larger to account for peat management and slope related costs. SP Transmission have now confirmed a new location for further investigation and development of the 275 kV substation at the coordinates shown in Table 3.

Vertex #	6 Figure Grid Reference – X	6 Figure Grid Reference - Y
1	[redacted]	[redacted]
2	[redacted]	[redacted]
3	[redacted]	[redacted]
4	[redacted]	[redacted]

Table 3: Carrick 275 kV substation location.

It is noted that it may be possible that there are significant levels of peat in the proposed location for the substation. For the purpose of preliminary cost estimations it is assumed that where peat excavation is required in order to accommodate the new 275 kV substation, it will be relocated locally. Where feasible, the excavated peat will be deposited within the boundary of the Carrick WF development. If this is found to be infeasible, costs associated with peat management and disposition are likely to increase.

Prior to procurement and construction phases, more extensive ground surveys and soil composition analysis will be conducted.

The proposed site layout can be found in Appendix A-3 along with an accompanying geological survey. The construction of the site is likely to be complicated due to the land in the region being entirely comprised of peat, raising environmental impacts. However, this issue is likely to arise with any works in the surrounding area.

3.3. Option 2 – New Carrick 275 kV Double Busbar AIS Substation

This option is to establish a new double busbar 275 kV substation at Carrick – 25 km northeast of the Mark Hill substation in south Ayrshire. This would be achieved by establishing the new Carrick substation between the Coylton and Mark Hill substations – situated along the YY route. The new

proposed Carrick substation would comprise five bays to accommodate both the [redacted] (WF) and [redacted]

Figure 3 shows the approximate proposed configuration for connection of the [redacted] under Option 1.

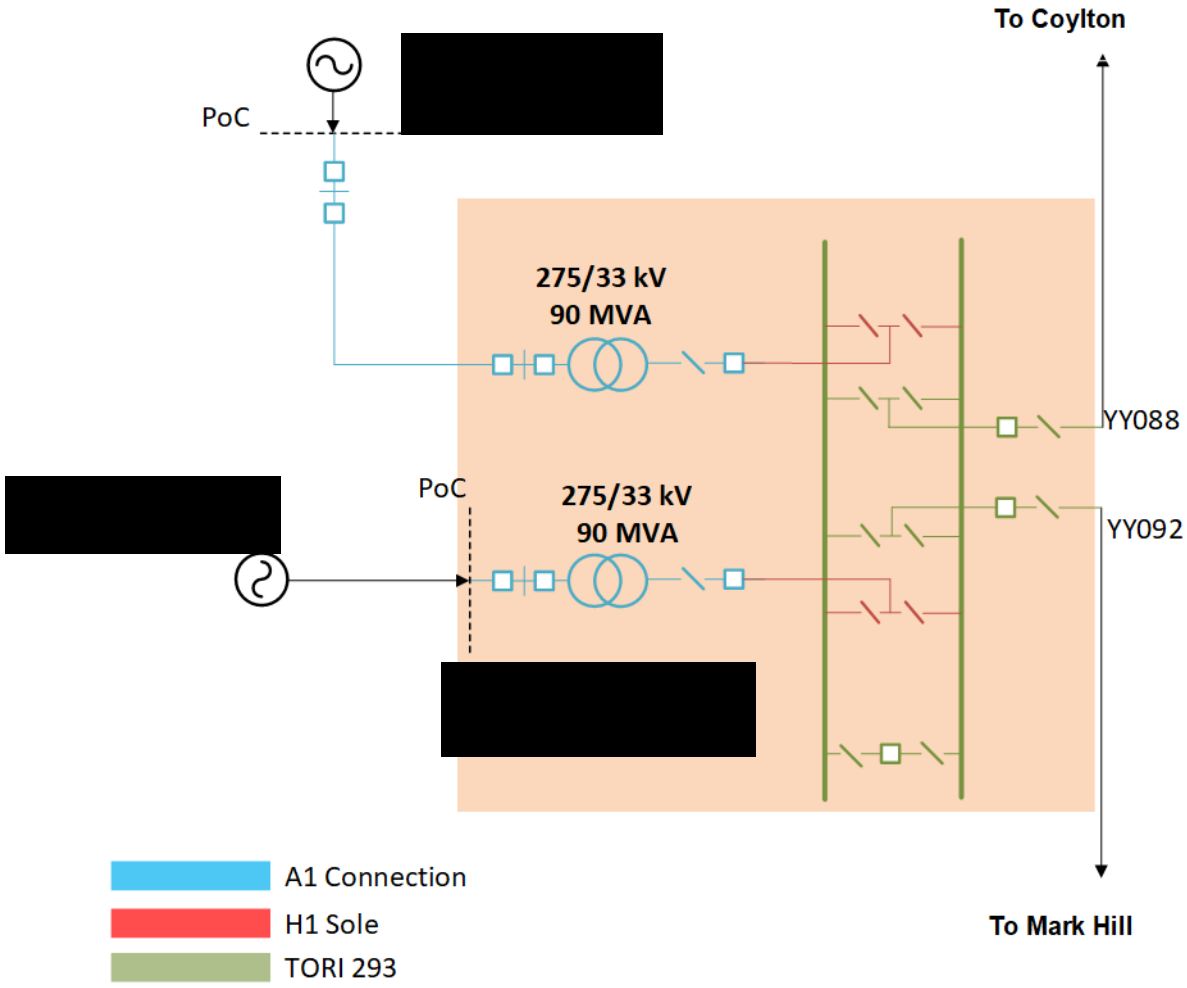

Figure 4: Option 2 proposed configuration.

Implementation of this option would require the following works:

- Construction and installation of the five bay 275 kV substation building, consisting of:
    - One 275kV incomer bay for the Coylton OHL (YY088)
    - One 275kV incomer bay for the Mark Hill OHL (YY092)
    - One 275kV bus-coupler bay
    - Two 275kV feeder bays for the 275/33 kV SGTs.
- Installation of two 90 MVA transformers to step the voltage down from 275 kV to 33 kV – one transformer for each of: [redacted]
- Installation of two indoor 33 kV metering CBs (and associated line isolators) at the Carrick 275 kV substation – one for [redacted].

- Installation of 33 kV metering switchgear for both the [redacted]. The POC for the [redacted] will be at the Carrick 275/33 kV substation.
- The POC for the [redacted], which is connected to the Carrick 275/33 kV substation via a 33kV underground cable.
- Installation of a protection scheme at both [redacted] substations to interface with NESO's OBP.
- Provision of necessary communications and signalling infrastructure to interface with NESO's OBP.
- All associated protection and control works.
- All associated environmental and civil works.
- Miscellaneous works.

As with Option 1, it is noted that the success of Option 2 is contingent on reinforcement works required as part of the implementation of the OBP being completed as per their expected completion dates of October 2025.

Creation of a new double busbar 275 kV substation at Carrick would allow for the connection of the generation offers detailed in Table 2 as well as providing reinforcement, resilience and additional capacity in the southern Ayrshire area at the expense of additional cost and footprint versus Option 1.

Originally the substation was set to be located on an incline with a 12 m difference in height between the fence lines – causing the predicted total cost to be much larger to account for peat management and slope related costs – this cost increases in Option 2, as a result of the increased substation footprint size.

As with Option 1, it is noted by SPT that it may be possible that there are significant levels of peat in the proposed location for the substation. For the purpose of preliminary cost estimations: it is assumed that where peat excavation is required in order to accommodate the new 275 kV substation, it will be re-deposited locally. Where feasible, the excavated peat will be deposited within the boundary of the [redacted] development. If this is found to be infeasible, costs associated with peat management and disposition are likely to increase.

Prior to procurement and construction phases, more extensive ground surveys and soil composition analysis will be conducted.

The proposed site layout can be found in Appendix A-3 along with an accompanying geological survey. The construction of the site is likely to be complicated due to the land in the region being entirely comprised of peat, raising environmental impacts. However, this issue is likely to arise with any works in the surrounding area.

3.4. Option 3 – Shared Carrick 275/33/33 kV dual LV winding Super Grid Transformer

Option 3 presents an alternative connection arrangement which instead of utilising 2 separate 90 MVA 275/33 kV transformers (one for each of: [redacted]), it is proposed that a single 3-winding 275/33/33 kV transformer be used instead. Implementation of this option would require the following works:

- Construction and installation of the 275 kV substation building.

- Installation of one 180 MVA three winding 275/33/33 kV transformer to step the voltage down from 275 kV to 33 kV – one secondary transformer winding each for: [redacted]
- Installation of two indoor 33 kV metering CBs (and associated line isolators) at the Carrick 275 kV substation – [redacted].
- Installation of 33 kV metering switchgear for both the [redacted].
- Installation of a protection scheme at both [redacted] substations to interface with OBP.
- Provision of necessary communications and signalling infrastructure to interface with OBP.
- All associated protection and control works.
- All associated environmental and civil works.
- Miscellaneous works.

Option 3 is presented diagrammatically in Figure 5.

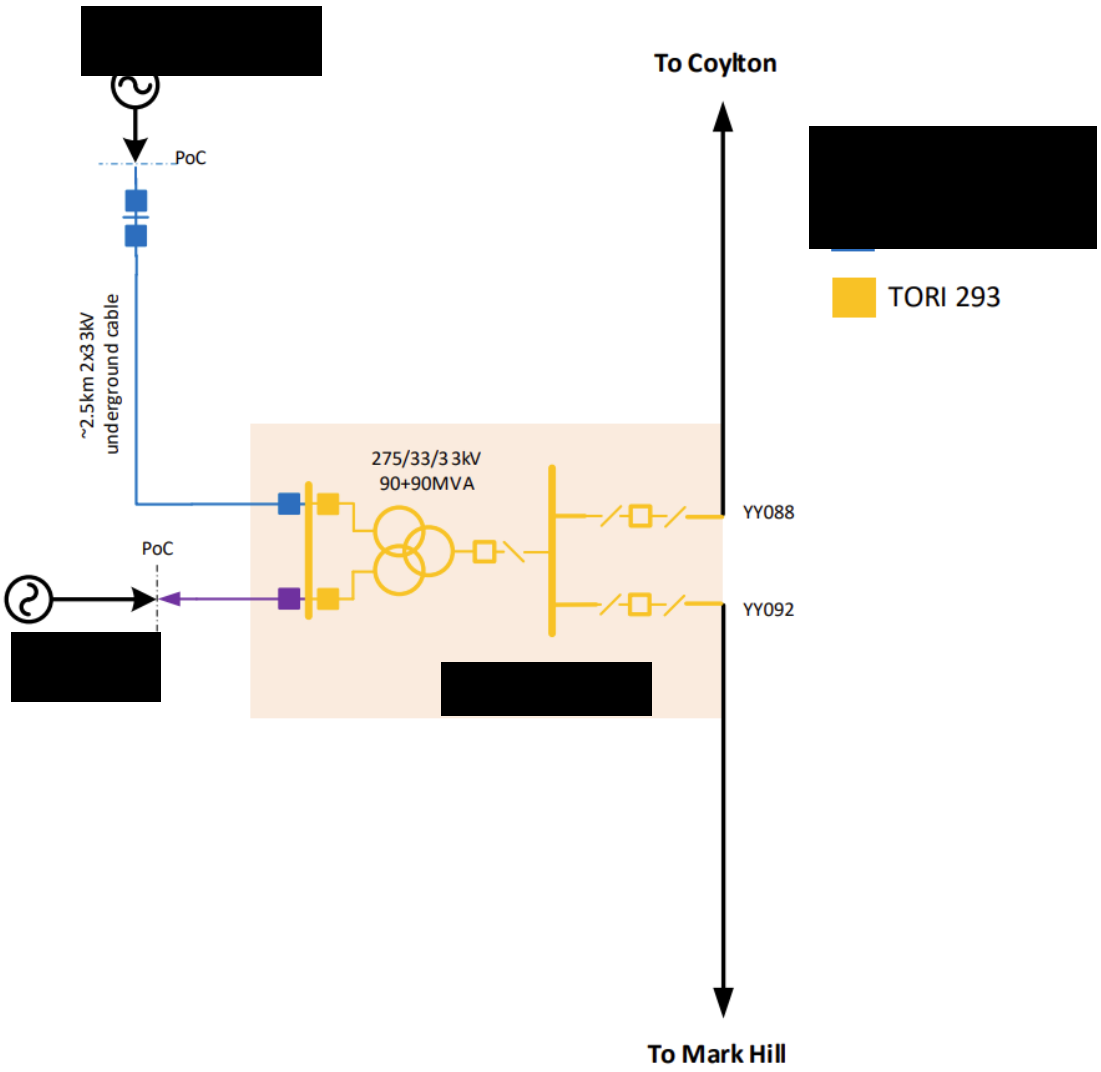

Figure 5: Option 3 proposed configuration

This option was discounted on the following grounds:

- The cost of one 3-winding transformer is approximately 10% more expensive than two 2-winding transformers.
- Technical concerns regarding voltage control and strategic spare availability if a single 3-winding transformer was used.
- The 3-winding transformer becomes cost-prohibitive if one connecting site does not reach financial close.

3.5. Option 4 – 132 kV connection at New Cumnock Board A

As an alternative to creating the Carrick substation entirely, it was proposed that instead the [redacted] would achieve connection through a 21 km 132 kV OHL from the site to the New Cumnock 132 kV substation A. Implementation of this option would require the following works:

- Installation of a 90 MVA 132/33 kV transformer at the [redacted].
- 33 kV metering CB at the [redacted].
- Approximately 21 km of 132 kV OHL from the [redacted]
- All associated protection and control works.
- All associated civil, environmental and miscellaneous works.

This option has been discounted on the following grounds:

- There is significant cost, complexity and threat to project completion associated with installation of long runs of 132 kV OHL.
- Connection of the [redacted] to the New Cumnock "A" Board has strict reliance on TORI 236 – a planned construction project to connect the New Cumnock network to ZV route via Glenmuckloch. Whilst this is due to be completed by October 2028 there remains risk in delays to the connection in the event that the new overhead line is delayed.
- To accommodate the Carrick Windfarm connection at the New Cumnock 'A' Board a SGT upgrade would be required.

Option 4 is presented diagrammatically in Figure 6.

Note, development of the [redacted] has been based upon the user's requested connection into the Carrick substation, and as such this is not included within the discussion of Option 3.

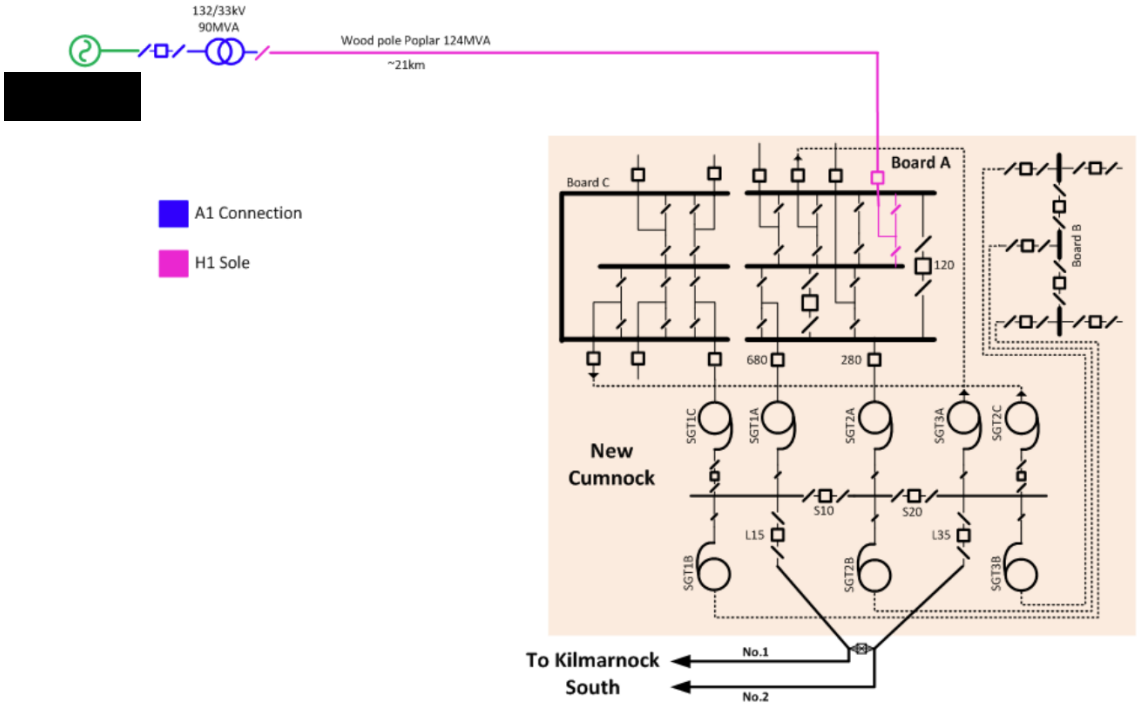

Figure 6: Option 4 proposed configuration.

3.6. Option 5 – 132 kV connection at Maybole

In a similar fashion to Option 3, an alternative method to connect the [redacted] would be to connect to the already established 132 kV Maybole substation. Similar works are therefore required:

- Installation of a 90 MVA 132/33 kV transformer at the [redacted] site.
- 33 kV metering CB at the [redacted] site.
- Approximately 14 km of 132 kV OHL from the [redacted].
- All associated protection and control works.
- All associated civil, environmental and miscellaneous works.

As with Option 3, there is significant cost, complexity and threat to project completion associated with installation of large runs of 132 kV OHL. In addition, connection of the [redacted] to Maybole 132 kV substation would be reliant upon the completion of TORI 3062, uprating of the Maybole to Coylton 132kV Overhead Line. As such, these factors combine to result in this option being rejected by SPT on the grounds of total cost.

Option 5 is presented diagrammatically in Figure 7.

Note, development of the [redacted] has been based upon the user's requested connection into the Carrick substation, and as such this is not included within the discussion of Option 5.

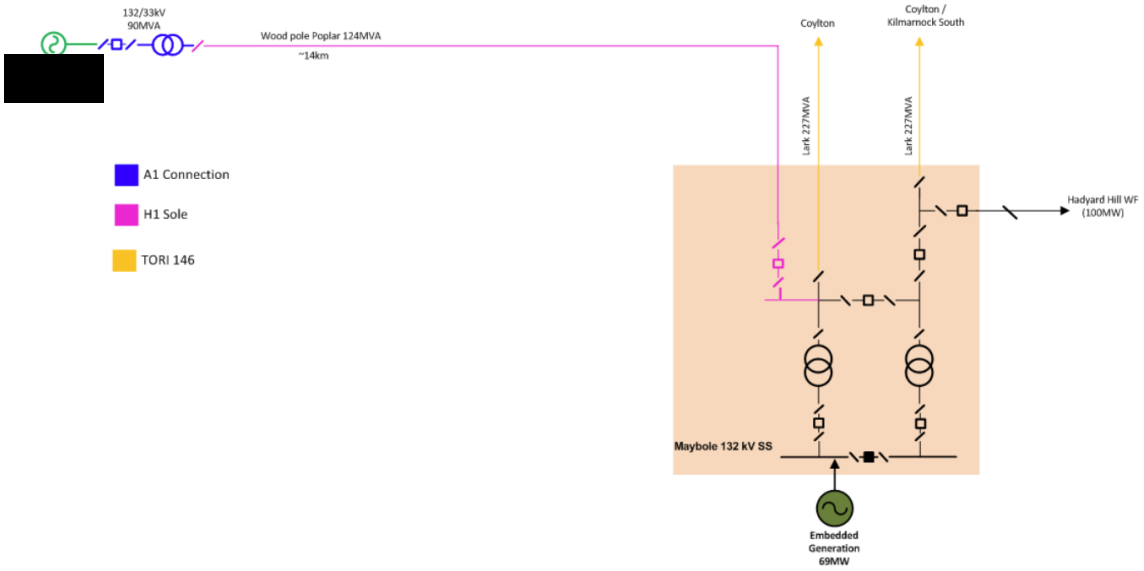

Figure 7: Option 5 proposed configuration.

Options	Map	Layout of Substation / Connection	Layout of all Route Works	Relevant Survey Works	Narrative Consenting Risks	Narrative Preferred Option	Narrative Rejection
Preferred – Option 1: New Carrick Single Busbar 275 kV substation	Refer to Appendix A-1	Refer to Appendix A-3	Refer to Appendix A-3	Refer to Appendix A-3	Early engagement with landowners and environmental bodies to secure necessary site permissions.	Necessary option to facilitate local generation from Carrick WF whilst maintaining the strongest chances of technical feasibility and economic success.	N / A
Rejected – Baseline: Do Nothing / Delay	N / A	N / A	N / A	N / A	N / A	N / A	Inconsistent with SPT's various statutory duties and licence obligations.
Rejected – Option 2 New Carrick Double Busbar 275 kV substation	Refer to Appendix A-1	Refer to Appendix A-3	Refer to Appendix A-3	Refer to Appendix A-3	N/A	N/A	Rejected on the basis of a total cost which is deemed too high in comparison with alternative options. It is more expensive and challenging to construct in comparison with the proposed scheme.
Rejected – Option 3 Shared Carrick 275/33 kV dual wound SGT	N / A	N / A	N / A	N / A	N / A	N / A	Unable to reliably achieve necessary voltage control and to benefit from common strategic spares. More expensive than two 2-winding transformers and becomes cost-prohibitive if one connecting site does not reach financial close.
Rejected – Option 4: 132 kV connection at New Cumnock Board A	N / A	N / A	N / A	N / A	N / A	N / A	Rejected on the basis of a total cost which is deemed too high in comparison with alternative options.
Rejected – Option 5: 132 kV connection at Maybole	N / A	N / A	N / A	N / A	N / A	N / A	Rejected on the basis of a total cost which is deemed too high in comparison with alternative options.

Table 4: Optioneering process summary

System Design Table	Circuit / Project	Preferred – Option 1: New Carrick 275 kV Single Busbar AIS substation	Rejected – Baseline: Do Nothing / Delay	Rejected – Option 2: New Carrick 275 kV Double Busbar AIS substation	Rejected – Option 3: Shared Carrick 275/33 kV dual wound SGT	Rejected – Option 4: 132 kV connection at New Cumnock Board A	Rejected – Option 5: 132 kV connection at Maybole
Thermal and Fault Design	Existing Voltage (if applicable)	N / A	N / A	N / A	275 kV	132 kV	132 kV
	New Voltage	275 kV	N / A	275 kV	275 kV	132 kV	132 kV
	Existing Continuous Rating (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	New Continuous Rating	3150 A	N / A	3150 A	3150 A	2000 A	2000 A
	Existing Fault Rating (if applicable)	N / A	N / A	N / A	N / A	40 / 31.5 kA	40 / 31.5 kA
	New Fault Rating	40/40 kA	N / A	40/40 kA	40/40 kA	40 / 31.5 kA	40 / 31.5 kA
ESO Dispatchable Services	Existing MVAR Rating (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	New MVAR Rating (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	Existing GVA Rating (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	New GVA Rating	N / A	N / A	N / A	N / A	N / A	N / A
System Requirements	Present Demand (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	2050 Future Demand	N / A	N / A	N / A	N / A	N / A	N / A

System Design Table	Circuit / Project	Preferred – Option 1: New Carrick 275 kV Single Busbar AIS substation	Rejected – Baseline: Do Nothing / Delay	Rejected – Option 2: New Carrick 275 kV Double Busbar AIS substation	Rejected – Option 3: Shared Carrick 275/33 kV dual wound SGT	Rejected – Option 4: 132 kV connection at New Cumnock Board A	Rejected – Option 5: 132 kV connection at Maybole
	Present Generation (if applicable)	N / A	N / A	N / A	N / A	N / A	N / A
	Future Generation Count	2	0	2	2	1	1
	Future Generation Capacity	143.4 MW	N / A	143.4 MW	143.4 MW	84 MW	84 MW
Initial Design Considerations	Limiting Factor				Cost, complexity, technical limitations, and spare equipment strategy	Cost, complexity, reliance on other TORI changes, long OHL runs	Cost, complexity, reliance on other TORI changes, long OHL runs
	AIS/ GIS	AIS	N / A	AIS	AIS	AIS	AIS
	Busbar Design	Single Busbar	N / A	Double Busbar	N / A	N / A	N / A
	Cable/ OHL/ Mixed	Cable	N / A	Cable	Cable	OHL	OHL

Table 5: Optioneering Technical Summary

3.7. Selected Option

While the Carrick 275 kV Substation is a greenfield site, there are a wide range of factors that must be considered when identifying a suitable location for the new substation:

- The extent of the initial substation design and allowance for future expansion
- The status of the potential sites, the land quality and designations
- The proximity to existing overhead line routes that are proposed to connect to the new substation.
- The effect on the present owners of the land identified for the new substation
- The effect on the community during the construction and operational stages of the substation's life

Upon the above optioneering analysis, it has been determined that the most appropriate method to allow connection of the new [redacted] into the SPT network would be by creating a new Carrick 275 kV single busbar substation along the YY route in southern Ayrshire between Coylton and Mark Hill 275 kV substations. The interface with YY route will be managed by an intertrip. [redacted] itself then be connected via 33 kV cables to separate 275/33 kV transformers at the Carrick 275 kV substation.

This option was selected mostly on the basis that it is both a cheaper and more cost-effective alternative to installing a single 3-winding transformer that serves both the [redacted] in one unit. Unlike Options 3 & 4, Option 1 also doesn't require reinforcement of 132 kV OHL – a significant cost element and technical risk.

When compared with implementation of a 275 kV double busbar substation (Option 2), the overall cost of the double busbar substation is higher than the Option 1 and provides limited benefit in terms of resilient connection to the wider network due to being sited on the single-circuit, radial connection between Coylton and Auchencrosh.

Provisionally, this new Carrick 275 kV substation will be located approximately at the grid reference locations stated in Table 3. However, given the project is at an initial development phase – this location is only an approximation and may be subject to change. Where peat needs to be excavated, SPT will attempt to relocate it to within the [redacted] boundary where possible. Increased project costs may be incurred as a result. The proposed location of the substation is depicted in Figure A-1, and an indicative proposed layout of the substation itself is shown in Figure 8.

The 275 kV substation will be constructed under SPT-RI-293 and will contain the following equipment:

- One 275kV incomer bay for the Coylton OHL (YY088)
- One 275kV incomer bay for the Mark Hill OHL (YY092)
- Two 275kV feeder bays for the 275/33 kV SGTs.
- 275/33 kV 90 MVA transformer – 2 units
- 33 kV indoor switchgear for metering purposes
- 33 kV circuit breakers on the WF side of the substation – 4 units

As there is not a substantial difference in the overall footprint required for the 275 kV AIS Substation versus a GIS option to support the required number of bays, as the total footprint area of the substation is dominated by the two 90 MVA SGTs located within the substation boundary. It is

therefore considered that the civil engineering and associated environmental planning challenges between the GIS and AIS options are roughly similar and the incremental cost for the GIS option due results in an AIS solution as the likely preferred option to be confirmed through detailed engineering.

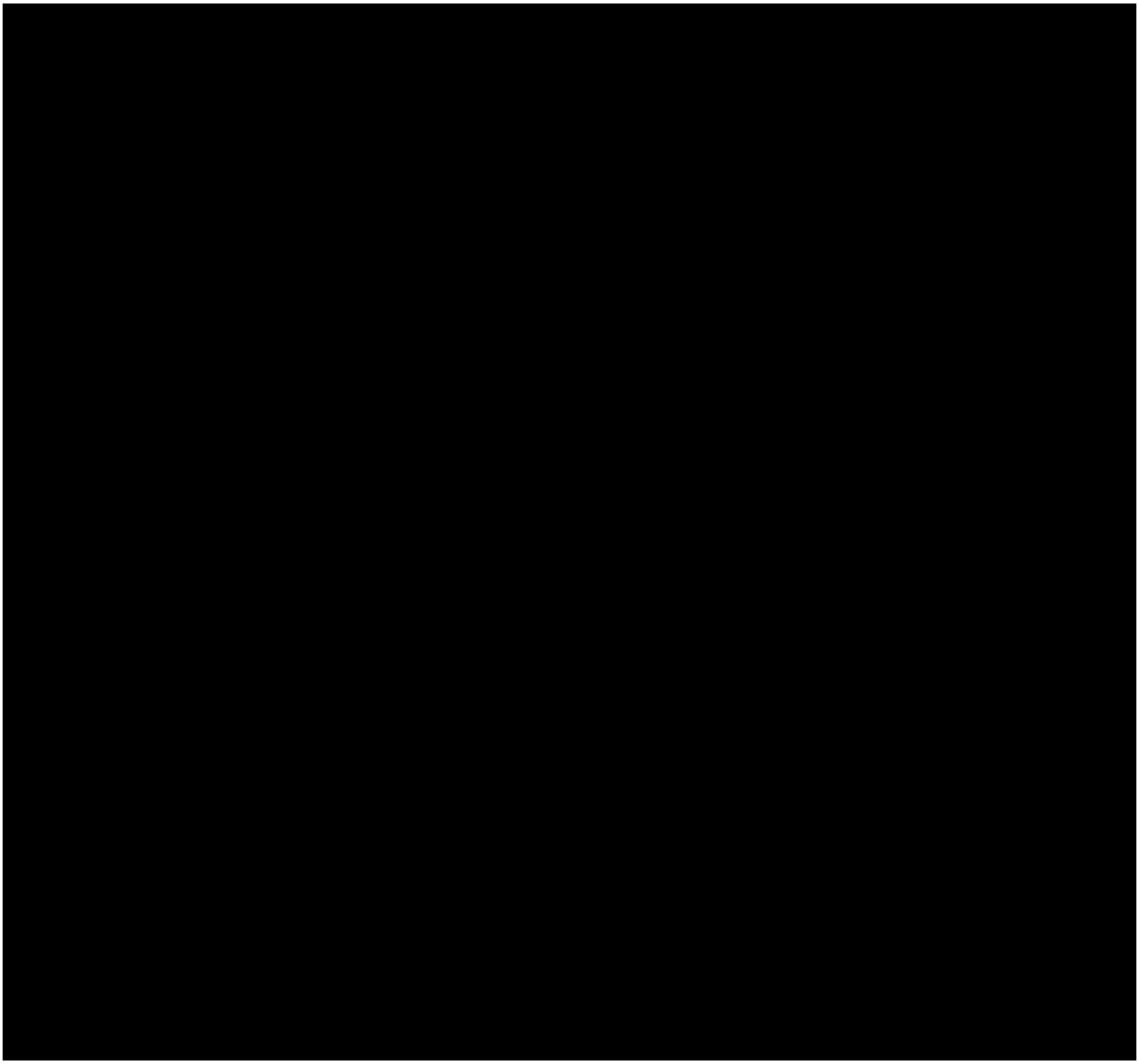

Figure 8: Carrick 275 kV Substation - Proposed Site Layout

4. Proposed Works and Associated Costings

4.1. Project Summary

The selected option details the installation of a 275kV substation, Carrick, with accompanying 275/33kV SGTs connected to a new 275kV single busbar, connected to the existing 275kV YY route between Coylton and Mark Hill. This will be a single stage process to ensure the project is delivered in a safe and timely manner.

The Carrick 275kV substation is to be established to provide a connection point for the [redacted] through two separate 275/33kV 90 MVA SGTs. The single line diagram for this stage of works is shown in Figure 9.

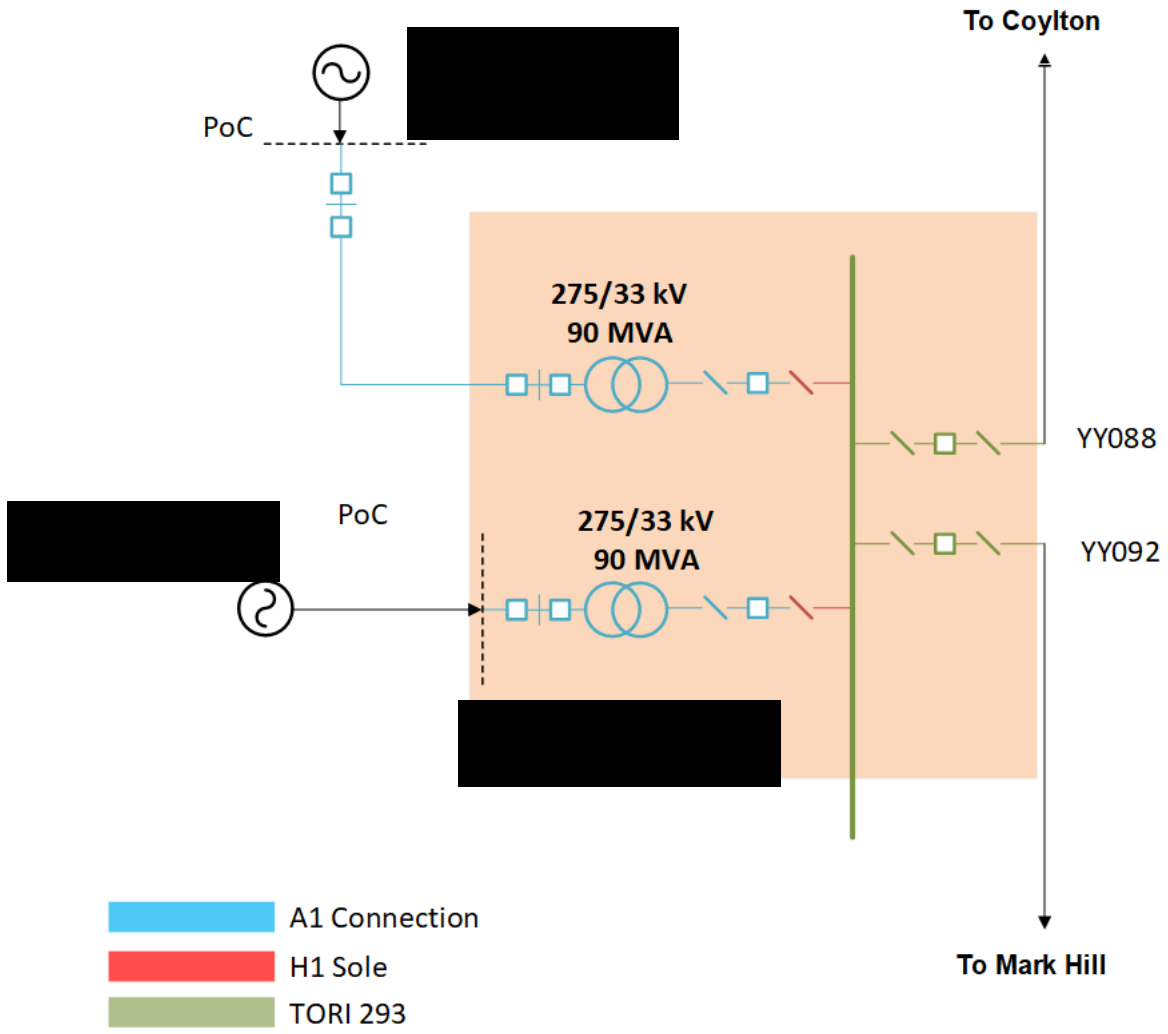

Figure 9: Stage 1 Indicative Works - Single Line Diagram

The associated works for the works are detailed below:

Pre-Engineering Works

The following list is indicative based on previous experience of such sites and as such should not be read as definitive. Topographical survey of the site

- GPR survey of areas to be excavated to validate approximate locations of buried services.

- Ground bearing capacity checks
- Geo Environmental Investigation to identify the relevant geotechnical parameters to facilitate the civil engineering design works
- Earthing Study
- Insulation Co-ordination Study
- Transport Survey to assess the access of the new equipment
- Environmental Study.

Carrick 275 kV substation

The works at Carrick 275 kV substation shall, as indicated in Figure 9, include:

- One 275kV incomer bay for the Coylton OHL (YY088)
- One 275kV incomer bay for the Mark Hill OHL (YY092)
- Two 275kV feeder bays for the 275/33 kV SGTs.
- 275/33 kV 90 MVA transformer – 2 unit
- 33 kV indoor switchgear for metering purposes
- 33 kV circuit breaker on WF side – 4 unit

4.2. Estimated Total Project Cost

A Business Plan provision and estimated cost of the project is indicated in the following table. Costs below are referred as "Direct", so neither risk contingency nor indirect have been included in the project cost.
Project costs are summarised in the Cost Breakdown below:

Table 7: Project Cost Breakdown

[redacted]		
[redacted]		
[redacted]		
[redacted]		
	TOTAL:	£13.78m

Expenditure incidence is summarised below, for the required Transmission Reinforcement Works associated with the development of the Carrick (SPT-RI-293):

Energisation Year	Yr. 2021: CAPEX	Yr. 2022: CAPEX	Yr. 2023: CAPEX	Yr. 2024: CAPEX	Yr. 2025: CAPEX	Yr. 2026: CAPEX	Yr. 2027: CAPEX	Yr. 2028: CAPEX	Yr. 2029: CAPEX	RIIO-T2 Total: CAPEX	RIIO-T3 Total: CAPEX	Total: CAPEX
2028	£0.004	£0.03	£0.03	£0.02	£0.17	£2.94	£6.90	£2.72	£0.97	£3.18	£10.60	£13.78

Table 8: Summary of Expenditure Incidence

4.3. Regulatory Outputs

The indicative primary asset outputs are identified in table below:

Table 9: Indictive Primary Asset Outputs

Asset Category	Asset Sub-Category Primary	Voltage	Forecast Additions[7]	Forecast Disposal
Substation Platform	Platform Creation	275/33kV	16954 m^2	-
Circuit Breaker	CB	275kV	4	-
Circuit Breaker	CB	33kV	4	-
Switchgear	Disconnector	275kV	4	-
Switchgear	Disconnector	33kV	4	-
Wound Plant	Transformer	275/33kV 90MVA	2	-

4.4. Future Development at the New Substation

Indicators from SP Distribution's Distribution Future Energy Scenarios (DFES) indicate growth in both demand and generation going forward in the area local to this proposed new substation, therefore provision will be made at the site to allow expansion of the local distribution system to provide additional capacity, if the need arises.

Engagement with SPD on this will continue as the project develops, to ensure the best solution for the GB consumer, at both Transmission and Distribution levels.

5. Deliverability

We have applied SPT's project management approach to ensure that this project work is delivered safely, and in line with the agreed time, cost and quality commitments. We have 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 have assigned a dedicated Project Manager 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.

5.1. Delivery Schedule

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. The table (see Appendix B-1 for full size chart and key) below summarises the key milestones within the delivery schedule for Stage 1 of this project.

[7] Forecast Additions are indicative pending further detail design.

ID	Task Name	Duration	Start	Finish	% Comp	Predecessors	Successors
0	Carrick & Knockcronal Wind Farm Connections (TOCOs 498 & 2166, Incl TORI 293)	2503 d	Fri 10/01/20	Tue 20/11/29	7%		
1	Key Milestones - Carrick Collector SS & Knockcronal WF (TOCO 2166, Inc. TORI 293)	2503 d	Fri 10/01/20	Tue 20/11/29	0%		
2	Project Design / Environmental Planning	454 d	Fri 10/01/20	Mon 18/10/21	100%		
3	Project Start	0 d	Fri 10/01/20	Fri 10/01/20	100%		45
4	IP1 Approved (KPI)	0 d	Fri 10/01/20	Fri 10/01/20	100%	45	636SS
5	IP2 Approved (KPI)	0 d	Thu 20/02/20	Thu 20/02/20	100%	49	637SS,639SS,147
6	Consents Process Started (KPI)	0 d	Mon 18/10/21	Mon 18/10/21	100%	62SS	
7	Engineering Development / Contract Placement	431 d	Mon 01/09/25	Wed 19/05/27	0%		
8	IP3 (Stage 1) Approved (KPI) (Knockcronal)	0 d	Mon 01/09/25	Mon 01/09/25	0%	58	623SS,640SS,642SS
9	SCA Approved (KPI)	0 d	Thu 18/12/25	Thu 18/12/25	0%	160	643SS,645SS,54FS-10 d
10	SPEN Development to SPEN Delivery Handover (KPI)	0 d	Mon 03/08/26	Mon 03/08/26	0%	89,160	
11	Issue of ITT (KPI) - Earthworks	0 d	Tue 16/06/26	Tue 16/06/26	0%	236	624SS,626SS,646SS,648SS,38FS-20 d,630SS
12	IP3 (Stage 2) Approved (KPI)	0 d	Fri 06/11/26	Fri 06/11/26	0%	224	
13	Contract Award (KPI) - Earthworks	0 d	Tue 15/12/26	Tue 15/12/26	0%	239	627FS-20 d,649SS,651SS
14	Consents Obtained (KPI)	0 d	Wed 19/05/27	Wed 19/05/27	0%	95	
15	Delivery	656 d	Mon 26/04/27	Tue 20/11/29	0%		
16	Site Access Gained (KPI)	0 d	Mon 26/04/27	Mon 26/04/27	0%	543SS	629SS,652SS,654SS
17	Plant Commissioned (KPI) - 30.06.2027 (30th October 28 - Mod App)	0 d	Mon 30/10/28	Mon 30/10/28	0%	571,573,574,578,581	39FS-20 d,655SS,657SS
18	IP6 Signed Off (KPI)	0 d	Tue 20/11/29	Tue 20/11/29	0%	602	658SS
19	Key Milestones - Carrick WF (TOCO 498)	2082 d	Wed 01/09/21	Tue 20/11/29	0%		
20	Project Design / Environmental Planning	43 d	Wed 01/09/21	Fri 29/10/21	100%		
21	Project Start	0 d	Wed 01/09/21	Wed 01/09/21	100%		
22	IP1 Approved (KPI)	0 d	Wed 01/09/21	Wed 01/09/21	100%		
23	IP2 Approved (KPI)	0 d	Wed 27/10/21	Wed 27/10/21	100%		
24	Consents Process Started (KPI)	0 d	Fri 29/10/21	Fri 29/10/21	100%	62	
25	Engineering Development / Contract Placement	431 d	Mon 01/09/25	Wed 19/05/27	0%		
26	IP3 (Stage 1) Approved (KPI) (Knockcronal)	0 d	Mon 01/09/25	Mon 01/09/25	0%	58	623SS,640SS,642SS
27	SCA Approved (KPI)	0 d	Thu 18/12/25	Thu 18/12/25	0%	160	643SS,645SS,54FS-10 d
28	SPEN Development to SPEN Delivery Handover (KPI)	0 d	Mon 03/08/26	Mon 03/08/26	0%	89,160	
29	Issue of ITT (KPI) - Earthworks	0 d	Tue 16/06/26	Tue 16/06/26	0%	236	624SS,626SS,646SS,648SS,630SS,41FS-20 d
30	IP3 (Stage 2) Approved (KPI)	0 d	Fri 06/11/26	Fri 06/11/26	0%	224	
31	Contract Award (KPI) - Earthworks	0 d	Tue 15/12/26	Tue 15/12/26	0%	239	627FS-20 d,649SS,651SS
32	Consents Obtained (KPI)	0 d	Wed 19/05/27	Wed 19/05/27	0%	95	
33	Delivery	209 d	Thu 01/02/29	Tue 20/11/29	0%		
34	Site Access Gained (KPI)	0 d	Thu 01/02/29	Thu 01/02/29	0%	587	629SS,652SS,654SS
35	Plant Commissioned (KPI) - 28th Feb 29	0 d	Wed 28/02/29	Wed 28/02/29	0%	592	655SS,657SS,42FS-20 d
36	IP6 Signed Off (KPI)	0 d	Tue 20/11/29	Tue 20/11/29	0%	602	658SS

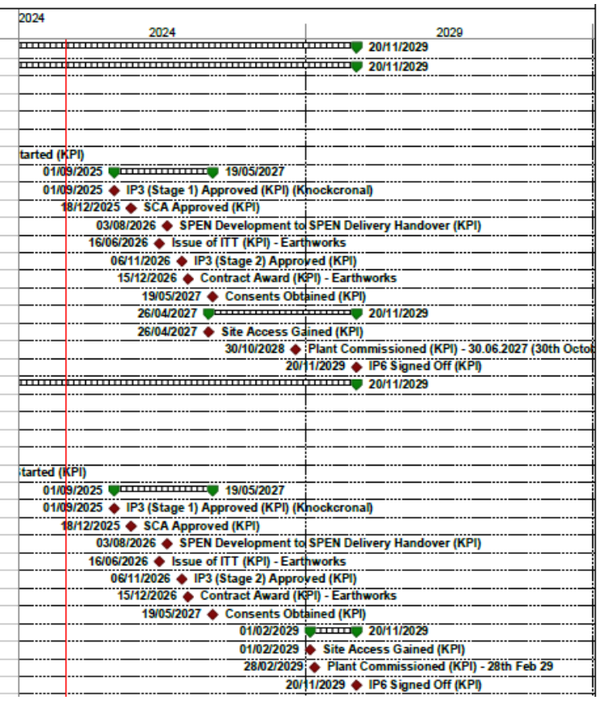

Table 6: Table of Key Project Milestones

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.

5.2. Risk and Mitigation

A Project Risk Register was generated collaboratively during the initial project kick-off meeting to identify any risks, which if realised, could result in deviation from the delivery plan. Mitigation strategies have also been 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 by the project team. Currently, the top scheme risks are:

- Ground Conditions – Ground investigations have not been carried out for the Carrick Substation. Poor ground conditions could have a great impact on the foundation/platform design which will impact cost and timeline of delivery.
- Servitudes, Lease, Wayleaves – Discussions with the Land Owner are yet to commence and may impact cost and timeline if not agreed.
- Servitudes, Lease, Wayleaves – Dependent upon the outcome of discussion with the Land Owner, a compulsory purchase order may be required which will impact the timeline of the development of the Carrick Substation scheme.

5.3. 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:

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.

5.4. 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.

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 completed:

- 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 is to determine compliance with:

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

5.5. Post Energisation

SPT Projects and SPT Operations 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.

5.6. 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 our business decision-making processes, ensuring compliance with or improvement upon legislative, industry, regulatory and other compliance obligations. We will deliver this by being innovative and demonstrating leadership on the issues which are important to us and our stakeholders, and will:

- Ensure the reliability and availability of our Transmission and Distribution network whilst creating value and delivering competitiveness by increasing efficiency and minimising losses.
- Reduce greenhouse gas emissions in line with our 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 our 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 our use of resources to sustainable levels, improve the efficiency of our 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 our network areas.
- Improve our service 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.

5.7. Stakeholder Engagement

SPT is committed to delivering optimal solutions in all the projects we undertake. A key part of this is engaging with relevant stakeholders throughout the project development and delivery process. Stakeholders can include 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.

6. Conclusions

This EJP establishes the requirement for a new Carrick 275 kV substation to allow integration of the 84 MW Carrick Windfarm and the 59.4 MW Knockcronal Windfarm into the SPT network. This EJP outlines the optioneering process that was followed to select the chosen option.

In summary, the main conclusions of this submission are:

- To increase the renewables penetration within the UK grid, it is important that SPT strive to incorporate wind power sources into the grid where technically and economically feasible.
- A new 275 kV Carrick substation should be created to allow connection of the [redacted]s.
- Reinforcement works required by the implementation of the OBP are completed in accordance with the planned timescales in order to facilitate the successful connection the [redacted].

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.

7. Appendices

7.1. Appendix A: Maps and Diagrams

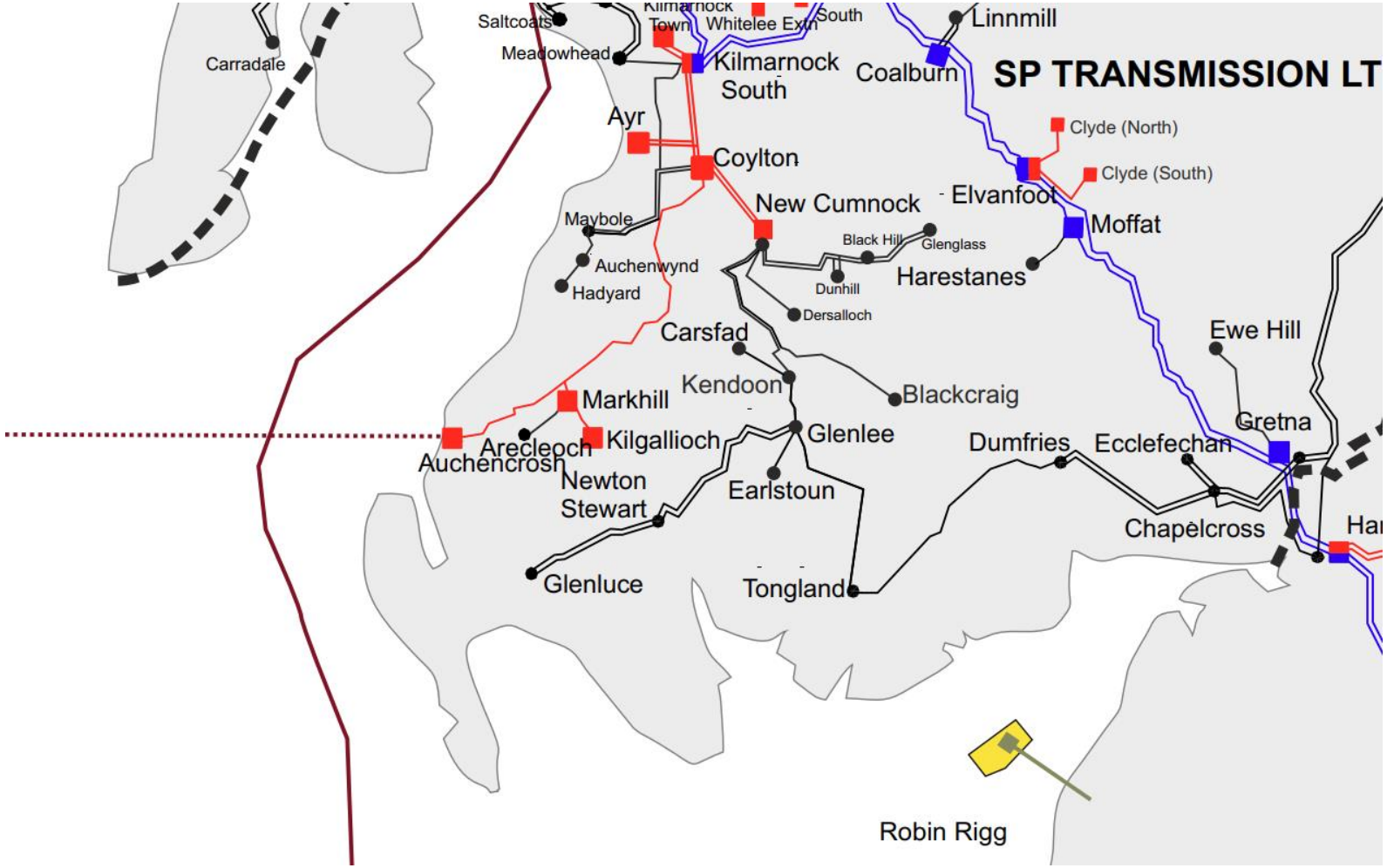

Figure A-1: Networks Diagram of the existing SPT system - Geographical Layout

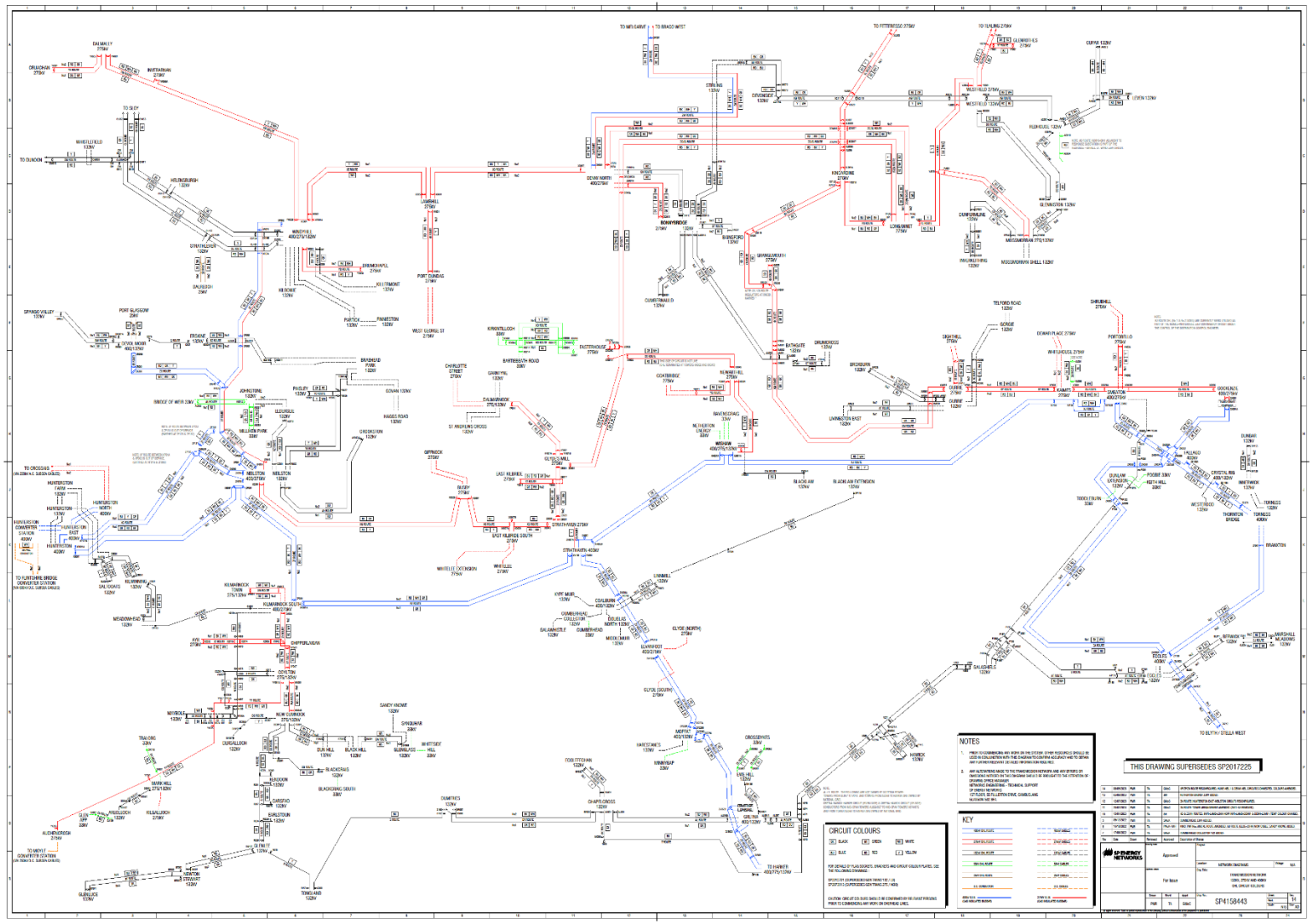

Figure A-2: Networks Diagram of the existing SPT system – Single Line Diagram

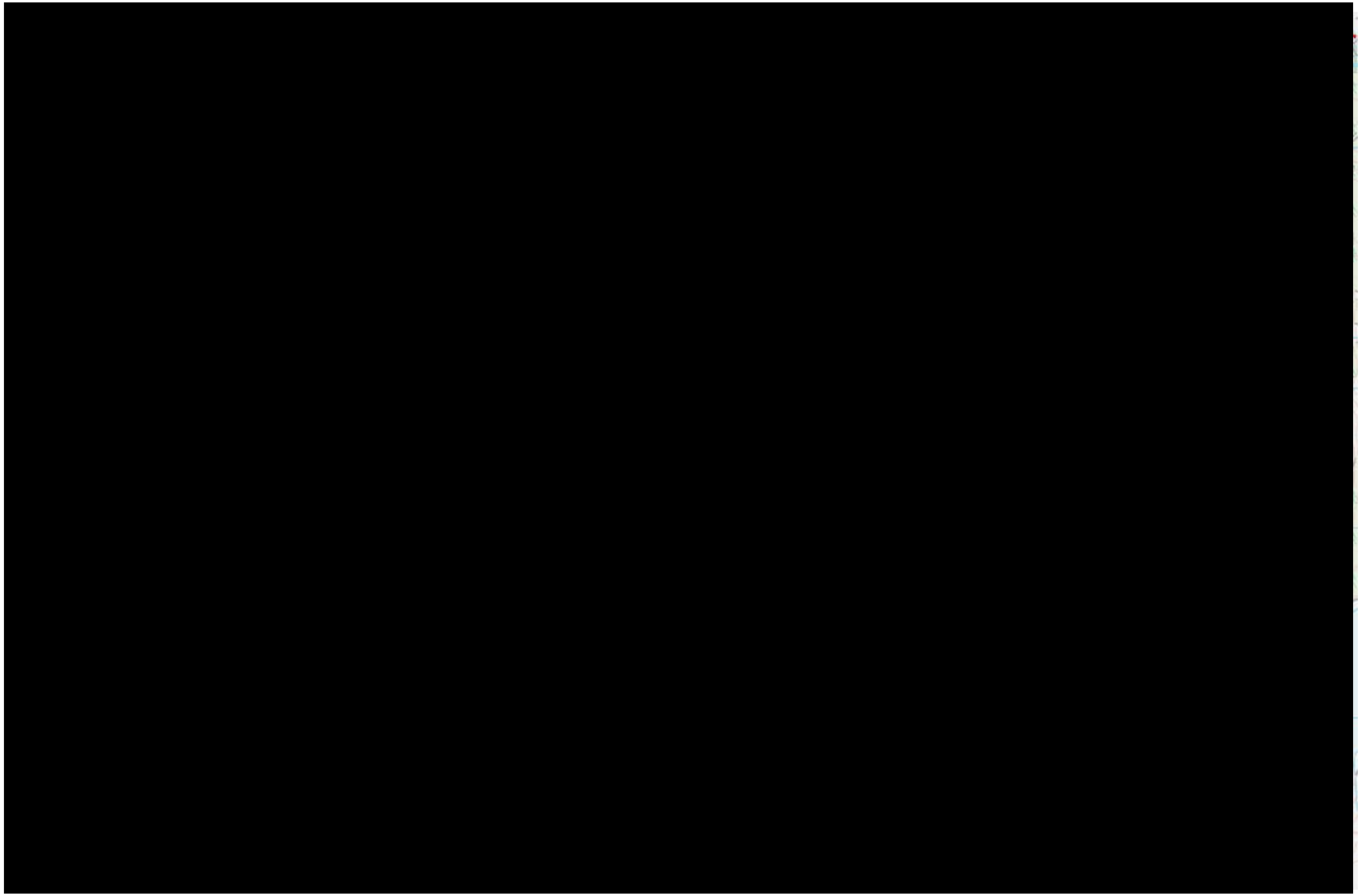

Figure A-3: Carrick 275 kV substation Region geological survey and Geographical Site Layout

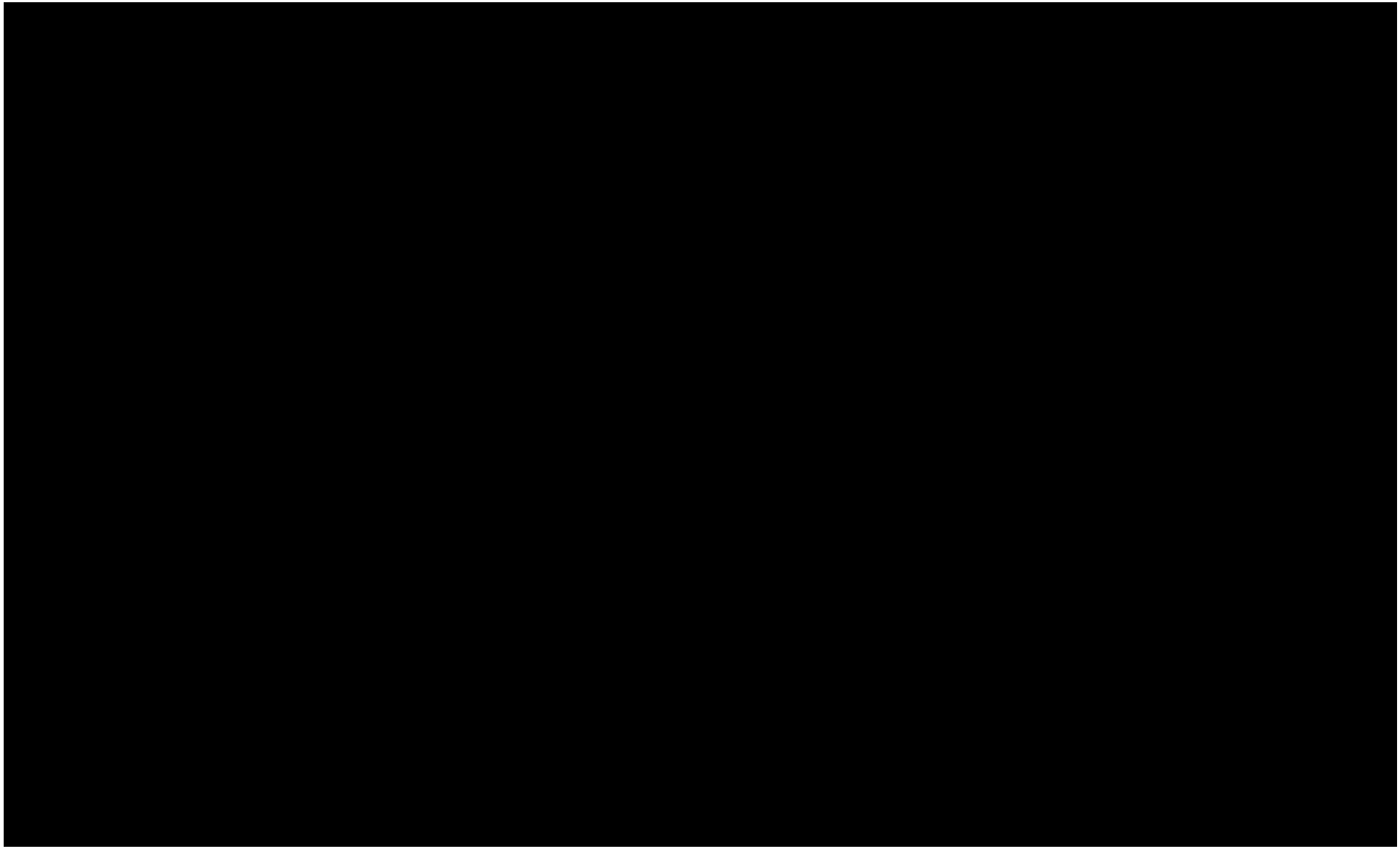

Figure A-4: Carrick 275 kV substation – Knockcronal Windfarm Proposed Underground Cable Routing