SP ENERGY NETWORKS

The Kendoon to Tongland 132kV Reinforcement Project

Underground cable study summary report

July 2020

Kendoon to Tongland Reinforcement (KTR) Project

Underground Cable Study Summary Report

This Report provides a summary of the Kendoon to Tongland 132kV Reinforcement (KTR) Project underground cable study and its overall conclusions. This should be read in conjunction with the technical reports produced by Cable Consulting International (CCI) Ltd. along with the associated appraisal tables for each stage of the assessment.

SP Energy Networks
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Executive Summary

As part of the design and environmental impact assessment process for the Kendoon to Tongland 132kV Reinforcement (KTR) Project, SP Energy Networks (SPEN) has been asked by the Scottish Ministers[1] to consider undergrounding options as an alternative to the proposed overhead lines. This is specifically in locations where these have been identified via the three rounds of pre-application consultation that SPEN has undertaken in relation to the KTR Project. The study of undergrounding and its conclusions will form part of the description of the main alternatives studied within the Environmental Impact Assessment Report (EIAR) to be submitted in support of the applications to the Scottish Ministers seeking consents under section 37 of the Electricity Act 1989.

To appropriately consider the undergrounding options as an alternative to the overhead lines, SPEN has undertaken a study of the options for the route sections identified through the three rounds of pre-application consultation. The reasons for the inclusion of the six cable route sections which emerged from the consultation process became the undergrounding objective for each section.

The six sections are as follows:

- Polquhanity to Kendoon
- Kendoon to Glenlee[2]
- Queen's Way Crossing
- Bennan, Slogarie and Laurieston Forests
- A75 crossing
- Glenlee to Tongland connection in its entirety

[1] KTR Project Scoping Opinion issued on behalf of Scottish Ministers by the Scottish Government Energy Consents Unit (October 2017). The Scoping Opinion has been interpreted as a request that undergrounding be included as an alternative studied by the applicant in terms of the requirements of regulation 5 (2) of the Electricity Works (Environmental Impact Assessment)(Scotland)Regulations 2017a

[2] Added March 2019 following further consideration of responses, relating to the Water of Ken valley, to the third round of consultation.

The study has been split into three separate stages:

- **Stage 1**: Optioneering Assessment undertaken to identify and appraise potential cable options for each route section, culminating in the selection of a preferred cable option for each section[3]. This process was led by SPEN's appointed cable consultants, Cable Consulting International Ltd (CCI), with environmental input from Land Use Consultants (LUC) and technical input from SPEN.
- **Stage 2**: Technical study[4] and costing of the preferred underground cable route for each section. This process was again led by CCI with environmental input from LUC and costing provided by SPEN.
- **Stage 3**: An appraisal of selected preferred cable options[5] against the proposed KTR overhead line (OHL) route alignments. This appraisal was undertaken by SPEN using the technical and environmental inputs from the stage 2 study and economic inputs from SPEN's in house engineering design teams. The appraisal was undertaken against SPEN's statutory and license duties i.e. technically feasible and efficient, economically viable and balancing effects on the environment and people.

The final conclusions of this study confirm that, in line with SPEN's statutory and licence duties, overhead line connections should be progressed for all route sections collectively comprising the KTR Project.

[3] Refer to Appendix 1 for CCI Stage 1 Optioneering Report (Kendoon to Tongland Preliminary Investigative Cable Route Study).
[4] Refer to Appendix 2 for CCI Report on the Technical Study of Preferred UGC routes
[5] Refer to Appendix 3 for SPEN final appraisal tables

1. Statutory and licence duties and the role of Ofgem

SPEN & SPT

SP Energy Networks (SPEN) is part of the ScottishPower Group of companies. SPEN owns the regulated electricity network businesses in central and southern Scotland. These businesses are 'asset-owner companies' holding the regulated assets and electricity transmission license (SP Transmission plc) and distribution license (SP Distribution plc) for central and southern Scotland. SPEN owns, operates, maintains and develops the network of cables, overhead lines and substations for these license areas[6].

Transmission License Obligations and the Role of Ofgem

SPEN is required under Section 9(2) of the Electricity Act 1989 to *develop and maintain an efficient, co-ordinated and economical system of electricity transmission*.

In addition, Schedule 9 of the Electricity Act 1989 imposes a further statutory duty on SPEN to take account of the following factors in formulating proposals for the installation of transmission lines. SPEN:

"(a) shall 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) shall do what he (it) reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects."

In terms of its electricity transmission license, SPEN is required to develop the transmission system in the most economic and efficient manner possible within the constraints of industry standards, statutory consents, approvals and permissions. Ofgem (the Office of the Gas and Electricity Markets) has to approve investment decisions within the transmission system and its role is to protect the electricity consumer from unnecessary or unjustified costs. Ultimately, the financial burden of constructing and operating the new transmission lines proposed under the KTR Project will be placed on electricity consumers throughout Great Britain.

In developing its proposals for the KTR Project, SPEN must therefore consider 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 interest. It must also do what it reasonably can to mitigate any effect of the proposals on these features. The KTR Project also requires to be compatible with SPEN's duties to develop and maintain an economic and efficient transmission system. The costs of proposals therefore require to be compatible with these duties. The same duties in terms of mitigating environmental effects and being economic and efficient, would also apply to any alternative proposals to the KTR Project (or sections of it) whether overhead or underground.

[6] The references within this Summary Report to SPEN in the context of statutory and licence duties should be read as applying to SP Transmission plc.

Therefore in considering whether overhead lines should be placed underground to obtain the benefits of reductions in landscape and/or visual effects, SPEN must balance those reductions in visual and/or landscape effects against the costs (economic and environmental) and the technical challenges of undergrounding.

The balance involved in selecting an underground cable route differs from that for an overhead line due to the need to strike a balance not only between underground cable system technical requirements, environmental and financial considerations, but also with the length of cable route. This is directly related to both cost and disturbance. With underground cable, the cost is the dominant consideration.

With all of these issues in mind, SPEN's overall objective has been to identify and develop proposals which are technically feasible and economically viable and which cause, on balance, the least disturbance to the environment and the people who live, work and enjoy recreation within it.

2. SPEN's approach

SPEN's general approach to routeing underground cables is set out in its published document "*Major Infrastructure Projects: Approach to Routeing and Environmental Impact Assessment*". The routeing methodology and overall strategy for routeing the overhead lines which form the KTR Project is set out within the Routeing and Consultation documents[7] which can be viewed under the Project Documents tab of the KTR website at www.spendgsr.co.uk.

The approach to routeing of cable options for the KTR Cable Study is summarised in section 5 below.

3. Background to the cable study

A fundamental part of the EIA process is the consideration of the main alternatives studied. For overhead line projects, this is normally taken to mean consideration of alternative overhead line routes. Notwithstanding SPEN's published approach to routeing major electrical infrastructure projects, the Scottish Ministers, in their scoping opinion (October 2017) stated that SPEN's Environmental Impact Assessment Report (EIA-R) for KTR should "*include information on alternative measures[8], including undergrounding, which have been considered to avoid, prevent or reduce and if possible offset the likely significant adverse landscape and visual effects where these have been identified through consultation feedback from affected communities or the routeing process e.g. 'pinch points' or cumulative effects on sensitive receptors.*"

In response to the Scottish Ministers' scoping opinion, taken with consultation feedback received from stakeholders and communities affected by the KTR Project, SPEN undertook a study of underground options for the areas identified through the three rounds of pre-application consultation (as noted in section 1, above).

[7] May 2015 & October 2016
[8] Issued on behalf of Scottish Ministers by the Scottish Government Energy Consents Unit (October 2017). The Scoping Opinion has been interpreted as a request that undergrounding be included as an alternative studied by the applicant in terms of the requirements of regulation 5 (2) of the Electricity Works (Environmental Impact Assessment)(Scotland)Regulations 2017.

4. Study aims and outputs[9]

The main aim of the study was to:

- Identify a technically feasible cable route, balancing environmental considerations (a preferred cable route), for each section of the KTR Project listed above; and
- Undertake a comparative appraisal of each preferred cable route option against the relevant equivalent overhead line alignments.

This appraisal was undertaken against the statutory and license duties (as described in section 2, above) and therefore focused on technical, environmental and economic (cost) issues.

The findings of the resulting appraisals will also be presented as alternatives in the KTR EIA Report (EIA-R) which will accompany the applications for section 37 consent to the Scottish Minsters.

5. Stage 1: Identification of cable routes

Roles and Responsibilities

SPEN engaged CCI to lead the process of identifying and selecting a preferred cable route option for each of the six sections where undergrounding was to be considered. As part of this, SPEN provided technical criteria consistent with SPEN's approach to routeing underground cables, which CCI subsequently reviewed and expanded on (refer to *Stage 1 Methodology*, below).

Furthermore, to assist in identifying potential cable route options, Land Use Consultants (LUC) provided initial environmental baseline information for the study area consisting of areas of highest and high amenity value to be avoided, wherever possible. This allowed CCI to identify potential cable options and undertake a technical appraisal, leading to the recommendation of a technical preference for each of the six cable route sections.

In parallel with the technical appraisal, LUC undertook a full desk-based environmental appraisal of each of the identified cable options, providing an environmental preference for each section (LUC appraisal tables can be found in Appendix 1, CCI Optioneering Report).

Once the technical and environmental preferences were available, CCI undertook a joint review of these recommendations in consultation with LUC and SPEN before finalising the conclusions on a preferred cable route for each of the six sections. SPEN was involved in this decision-making process as it is SPEN, as the transmission licence holder, that would have to promote and ultimately deliver any future cable solutions which may be brought forward as part of the KTR Project.

[9] SPEN published the overall approach to this study in "Underground Cable Study: Our Approach" (November 2018) which can be viewed at www.spendgsr.co.uk

Stage 1 Overview

The underground cable (UGC) sections, identified by CCI, are numbered from north (Polquhanity) to south (Tongland). The sections are listed below in Table 5.1 and include references to the corresponding tower numbers identified from SPEN's final overhead line alignment. These sections were prescribed by SPEN considering the feedback received from communities during the three rounds of pre-application consultation. The reason for including each section in the study (taken from the Summary of Feedback Reports for the second and third rounds of consultation) is provided in table 5.1 below. The reason for the inclusion of each route section became the undergrounding objective to be met for that section.

Table 5.1

Section	Tower No's	Reason for inclusion in study/Undergrounding Objective to be met
UGC1 Polquhanity to Kendoon	N230 – PK10	Suggestion that placing this connection underground could help mitigate impacts on commercial forestry and on the setting of cultural heritage features within Polmaddy forest.
UGC2 Kendoon to Glenlee	PK10 – PK33	Suggestion that placing the line underground would mitigate potential landscape and visual impacts of the proposed overhead line on the Water of Ken valley.
UGC3 Queen's Way Crossing	GT08 – GT21	Suggestion that placing this line underground would mitigate potential landscape, visual, tourism and recreation impacts on the Queen's Way crossing tourist route between New Galloway and Newton Stewart, the gateway into the Galloway Forest Park.
UGC4 Bennan, Slogarie & Laurieston Forests	GT25 – GT78	Suggestion that placing this line underground would mitigate potential landscape, visual, tourism and recreation, forestry, ecology and ornithology impacts on receptors within the Bennan, Slogarie and Laurieston forest areas within the Galloway Forest Park.
UGC5 A75 Crossing	GT97 – GT104	Suggestion that placing the line underground in this location would mitigate potential landscape and visual impacts of the proposed overhead line crossing of the A75 tourist route between Dumfries and Stranraer.
UGC6 Glenlee to Tongland	GT001 – GT120	Suggestion to ensure consistency with the approach to routeing of the overhead line i.e. a 'blank sheet' approach to identifying potential cable route options both east and west of Loch Ken to ensure all effects are identified and understood.

Stage 1 CCI Cable Routeing Methodology

The CCI Optioneering Report carried out for stage 1 (see Appendix 1) describes CCI's optioneering assessment and the subsequent cable route preference for each of the six sections identified above.

Cable options were identified and appraised utilising site survey work and desktop analyses. The key criteria used to identify potential cable routes was developed and set out by SPEN's engineering teams pulling on their knowledge and experience of routeing and designing similar types of cable installations. The criteria were passed on to CCI for consideration at the outset of the process and included the following:

1. Safety and reliability
2. Constructability
3. Suitable locations for transition between OHL and cable (cable sealing ends)
4. Ease of access for construction and future circuit maintenance
5. Impact on local environment during construction and ability to mitigate this
6. Ground conditions, including risk of contamination and ground stability
7. Need to cross wet areas and/or habitats that are difficult to reinstate.
8. Flood risk, proximity to water supplies and ability to cross watercourses at their narrowest point.
9. Long term visibility of cable routes post construction, including the length that will be seen and distances at which cable routes will be visible.
10. Long term loss of landscape features such as hedges or trees
11. Long term impact on known and unknown archaeology

The following are typical additional criteria that CCI consider when selecting a cable route:

12. Topographical and geological features
13. Access for both the construction phase and future maintenance of a project
14. Crossing positions at watercourses, access, ground suitability and elevational alignment

Following review and discussion with CCI, SPEN provided additional criteria to be considered during the identification and appraisal. These were as follows:

15. Reference should be made to the potential requirement for cable sealing end compounds (effectively fenced substation areas) being required on the UGC1 route OHL/cable transitions at L7 towers N230 and PK10[10]. This is due to the requirement for 2 cables per phase being required to accommodate the OHL circuit rating.
16. Reference should be made to the fact that Glenlee to Tongland cable route options can accommodate sealing ends on the L4 towers themselves.
17. Consideration should be given to the requirement for future vehicular access (suitable for a works van e.g. Road going 'Transit Van' light goods vehicle) to the 132kV cable joint and fibre cable joint locations for maintenance purposes.
18. Where transmission cables are intended to be run away from the public highway on or adjacent to forestry tracks, there is a requirement to ensure that the track will continue to be maintained for the life of the asset (40 years) to confirm that access to joint locations will always be available.
19. There is also a requirement to ensure that the cable installation route (within/adjacent to a forestry track) is not subject to risk of water washout and forestry ploughing/drainage machinery.

Finally, to assist CCI, GIS mapping, including areas of highest environmental value and high-level constraints information such as European designated habitats and cultural heritage sites, were made available by LUC to aid the identification of cable route options. In addition, landscape and visual considerations were also taken into account, informed by the work undertaken by LUC as part of the OHL routeing and consultation process.

Summary of Underground Cable Options

For the full technical appraisal of points of engineering difficulty and environmental sensitivity please refer to the CCI reports in Appendices 1 and 2 respectively.

UGC1 Polquhanity to Kendoon

A total of three UGC route options were identified in this section. These options are summarised in the table below and can be viewed in figures 1.1A – 1.1C. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.1 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

[10] For the purposes of this study it was assumed that the proposed L7 tower design, incorporating two conductors per phase, would require a separate sealing end compound to terminate overhead line to cable. For the proposed L4 tower design it was assumed that these sections, with a single conductor per phase, could be terminated to a sealing end platform attached to the tower. These are described in further detail in Appendix 2.

Table 5.2

Option	Route Length	Description
UGC1A	3.2km	The route would be cabled on to the A713 from a new cable sealing end compound (approximately 16m x 25m, refer to Figure 3.1) adjacent to the existing cable sealing end compound and terminal tower located on agricultural land to the south of Polquhanity Farm, west of the A713. From there the route would head south before exiting the A713 corridor south of Dundeugh. The route would then cross the Water of Ken before circling the south and east of the village of Kendoon to enter the existing substation.
UGC1B	2.9km (2.37km of cable and 0.53km of OHL)	This route is the same as option UGC1A, with the exception that it diverts from the A713 to terminate at the proposed new tower PK10, with the closing section into Kendoon substation being OHL. This option would also require the construction of a new cable sealing end platform (approximately 16m by 24m, refer to Figure 3.2) immediately adjacent to proposed tower PK10, west of the A713 at Kendoon.
UGC1C	2.9km	This option follows the wayleave of the proposed overhead line from the cable sealing end at tower N230 south through commercial forestry before crossing Polmaddy river west of the A713. From here the route continues within the forest before turning east, crossing the Water of Ken and entering Kendoon substation.
Preferred cable option		The environmental preference for this section was option UGC1B as it would involve less felling and would minimise effects on the riparian environment around the Water of Ken crossing. However, this was balanced against localised significant landscape and visual effects arising from the introduction of a new sealing end tower and compound at tower PK10. On consideration of the points of engineering difficulty and environmental sensitivity, as highlighted by LUC, CCI recommended that cable route option **UGC1B** be adopted as the preferred cable option for the Polquhanity to Kendoon section. This cable route option presents the most practicable option for cable installation and is of a similar length to the OHL route option. The inclusion of an overhead line section into Kendoon substation negates the many points of engineering difficulty associated with accessing the Kendoon substation site, even though construction of an OHL cable sealing end compound at PK10 would require the placement of additional above ground structures within sight of the A713 (refer to Figures 3.1 and 3.2). This option would also require the use of the OHL option on UGC2 (see below) into Kendoon substation from PK10. Furthermore, it was agreed that the selection of cable route option UGC1B wholly met the undergrounding objective for the UGC1 cable study which was to identify a route that mitigates impacts on commercial forestry and on setting of cultural heritage features within Polmaddy forest.

UGC2 Kendoon to Glenlee

A total of three route options were identified in this section. These options are summarised in table 5.3 below and can be viewed in figures 1.2A – 1.2C. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.2 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

Table 5.3

Option	Route Length	Description
UGC2A	8.97km	This option runs from north to south, from Kendoon substation, south to Glenlee substation, passing west of Carsfad Loch and Earlstoun Loch. The route predominantly follows the A713 and A762 carriageways. The exception to this is adjacent to Earlstoun Power Station, where the cable route crossed the Water of Ken to avoid infrastructure associated with the hydroelectric Power Station operation.
UGC2B	8.43km (7.3km of cable and 1.13km of OHL)	This route is the same as UGC2A, with the following two exceptions; at the northern end of the route it diverts from the A713 to terminate at the proposed new tower PK10 with a section of OHL into Kendoon. At the southern end, the route diverts from the A762 to terminate at sealing end compounds adjacent to proposed new tower PK33 (two separate compounds each approximately 24.5m x 15m, refer to figure 3.3) with a section into Glenlee substation being OHL.
UGC2C	7.7km	This cable route option follows the proposed OHL route from Kendoon substation to Glenlee substation.
Preferred cable option		The environmental preference for this section was option UGC2C as it was the shortest route requiring the least felling. It would also result in substantially fewer visual effects on residential receptors in comparison to UGC2B while crossing fewer flood risk zones than UGC2A and UGC2B. On consideration of the points of engineering difficulty and environmental sensitivity, CCI recommended that cable route option **UGC2B** be adopted as the preferred cable option between Kendoon and Glenlee substations (towers PK10 to PK33 with short OHL sections into both substations). This conclusion was predicated on cable route UGC2B being the preference for the technical considerations, which on balance were given precedence to the specific environmental considerations in this instance. The recommendation was made in acknowledgement of the fact that cable route UGC2B only partially met the undergrounding objective (as the UGC would still have an impact on the Water of Ken valley, particularly during construction) for the UGC2 cable study which was to identify a route that mitigates potential loss of landscape and visual amenity associated with the proposed overhead line.

UGC3 Queen's Way Crossing

Two route options were identified in this section. These are summarised in the table below and can be viewed in figures **1.3A** and **1.3B**. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.3 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

Table 5.4

Option	Route Length	Description
UGC3A	4.2km	This option runs from north to south between proposed new OHL towers GT08 to GT21. GT08 is located to the north and west of Airie Cottage on the lower slopes of Gallows Knowe, from there the route heads south east following the eastern shoulder of Achie Hill before crossing the Queen's Way to the west of Cairnraws Cottage. After crossing the road and Knocknairling Burn, the route heads through an area of recently felled commercial forestry and farmland to the east of Peal Hill before re-entering the Forest estate. The route then runs adjacent to an existing forest track before terminating at proposed tower GT21, east of Benbrack hill. It is assumed that sealing ends could be accommodated on platforms attached to towers GT08 and GT21, therefore no separate sealing end compounds would be required at these locations[11].
UGC3B	3.6km	This cable option follows the proposed OHL route between towers GT08 and GT21. It is assumed that sealing ends could be accommodated on platforms attached to towers GT08 and GT21, therefore no separate sealing end compounds would be required at these locations.
Preferred cable option		The environmental preference for this section was option UGC3A, primarily because this will require the least felling of the two options considered. Following consideration of the points of engineering difficulty and environmental sensitivity, CCI recommended that cable route option **UGC3A** be taken forward as the preferred cable route option for the Queen's Way crossing. This conclusion was predicated on cable route UGC3A being the preference for both the technical and environmental considerations. The recommendation was made in acknowledgement of the fact that cable route UGC3A partially met the objective (as the UGC will still have an impact on the Queen's Way crossing, particularly during construction) for the UGC3 cable study which was to mitigate potential landscape, visual, tourism and recreation impacts on the Queen's Way crossing tourist route between New Galloway and Newton Stewart, the gateway into the Galloway Forest Park.

[11] The Glenlee to Tongland route sections could be terminated on to a platform attached to the tower body due to the number of cables per phase required for this connection (only three cables per circuit). This contrasts with the Polquhanity to Glenlee sections where six cables per circuit are required meaning that a separate sealing end compound is required to terminate from overhead line to cable and vice versa. Further information on methods of cable termination can be found in section 4.4 of Appendix 2 (CCI Report - Technical Study of the Preferred UGC Routes for KTR).

UGC4 Bennan, Slogarie and Laurieston Forests Route Options

A total of three route options were identified in this section. These options are summarised in the table below and can be viewed in figures **1.4A – 1.4C**. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.4 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

Table 5.5

Option	Route Length	Description
UGC4A	14.2km	This cable route option starts at the proposed tower GT25 within commercial forestry north and west of Cairn Edward Hill in the Bennan forest. From there it joins the existing forest track (the Raider's Road) following this south past Stroan Loch before crossing the River Dee immediately north of the Slogarie Estate. The route then passes through the Slogarie Estate (east of Slogarie Farm house) before re-joining existing forest tracks within Laurieston Forest. The route then crosses the Laurieston to Gatehouse of Fleet Road east of the Kennick Burn car park then re-joins the existing forest tracks and heads south to terminate at proposed tower GT74. It is assumed that sealing ends could be accommodated on platforms attached to towers GT25 and GT74, therefore no separate sealing end compounds would be required at these locations.
UGC4B	13km	This cable route option follows that of the proposed OHL wayleave between towers GT25 and GT74.
UGC4C	16.1km	This cable route option starts at proposed tower GT25 then follows the same alignment as UGC4A along the Raider's Road. The route then deviates along the Mossdale to Gatehouse Station Railway walk before joining the A762 south of Mossdale. The route follows the carriageway of the A762 south through Laurieston before leaving the A762 carriageway south of Dinnance Farm to terminate at proposed tower GT78. It is assumed that sealing ends could be accommodated on platforms attached to towers GT25 and GT78, therefore no separate sealing end compounds would be required at these locations.
Preferred cable option		The environmental preference for this section was option UGC4C. Even though it is a longer cable option, it requires the least felling and would have the least impact on the Raider's Road and other recreational routes paralleling the A762. Following consideration of the points of engineering difficulty and environmental sensitivity, CCI recommended that cable route option **UGC4C** be taken forward from the three route options investigated for the proposed OHL crossing of Bennan, Slogarie and Laurieston forests. This cable route option presents the most practicable option for cable installation as it negates many of the points of engineering difficulty associated with cabling through dense forest and peat habitats. In addition, option UGC4C offers the best access both during the installation phase and after when access for future maintenance work is required.

	The recommendation was made in acknowledgement of the fact that cable route option UGC4C only partially meets the undergrounding objective which was to mitigate potential landscape, visual, tourism and recreation, forestry, ecology and ornithology impacts on receptors within the Bennan, Slogarie and Laurieston forest areas within the Galloway Forest Park. In particular the UGC will still have an impact on the Bennan Forest, particularly during construction.

UGC5 A75 Crossing

Two route options were identified in this section. These options are summarised in the table below and can be viewed in figures **1.5A – 1.5B**. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.5 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

Table 5.6

Option	Route Length	Description
UGC5A	2.2km	This route starts at proposed tower GT97 north of Upper Balannan Farm. The route broadly follows the wayleave of the proposed overhead line, with a deviation east then south to avoid environmental and geological sensitivities including peat and residential properties, before crossing the A75 and terminating at proposed tower GT104. It is assumed that sealing ends could be accommodated on platforms attached to towers GT97 and GT104, therefore no separate sealing end compounds would be required at these locations.
UGC5B	2.03km	This route follows that of the proposed overhead line wayleave between towers GT97 and GT104. It is assumed that sealing ends could be accommodated on platforms attached to towers GT97 and GT104, therefore no separate sealing end compounds would be required at these locations.
Preferred cable option		There was no clear environmental preference between the two cable route options considered, largely owing to few environmental sensitivities in this location. Following consideration of the points of engineering difficulty and environmental sensitivity, CCI recommended that option **UGC5A** be adopted as the preferred cable route for this section. This conclusion was predicated on cable route UGC5A being the preference due to the technical considerations. In this instance there was no environmental preference owing to presence of few environmental constraints within the UGC5 study extents. The recommendation was made to adopt UGC5A in acknowledgement of the fact that cable route UGC5A wholly met the undergrounding objective for the UGC5 cable study which was to mitigate potential landscape and visual impacts of the proposed overhead line crossing of the A75 tourist route between Dumfries and Stranraer.

UGC6 Glenlee Substation to Tongland Substation

A total of five route options were identified in this section. These options are summarised in the table below and can be viewed in figures **1.6A – 1.6E**. The detailed breakdown of each route option and their points of engineering difficulty can be found in Section 4.6 of the CCI Optioneering Report (Appendix 1). A detailed breakdown of the environmental sensitivities considered is also included in the stage 1 appraisal tables which are appended to the CCI Optioneering Report (Appendix 1).

Further to the five options UGC6A-E considered within the Optioneering Report, at SPEN's request following feedback received during the three rounds of consultation, CCI also considered the potential for installing the cable within Loch Ken. CCI gave consideration to a number of different issues before concluding that an underwater cable option within Loch Ken should not be assessed for UGC6. A full breakdown of the issues considered by CCI can be found in section 4.6.1 of the CCI Optioneering Report (Appendix 1).

Table 5.7

Option	Route Length	Description
UGC6A	31.24km	This route leaves Glenlee substation following the minor road (U2S) before joining the A762 towards New Galloway. The route leaves the A762 east of the property of Shiel heading south across farm land before crossing the Queen's Way (A712) west of New Galloway. South of the Queen's Way, the route passes through High Wood to the south of New Galloway Golf Club before skirting Burnfoot Cottage and re-joining the alignment of the A762 heading south along the western bank of Loch Ken. The route continues south following the line of the existing A762 before diverging from A762 north of Ringford to cross the A75 west of Tarff Station. From there, the route broadly parallels the route of the A762, west of Bar Hill, through a mix of woodland and farmland, approaching Tongland substation from the south west.
UGC6B	31.34km	Upon leaving Glenlee substation, this route follows the route of the proposed overhead line wayleave south through Bank Wood and crossing the minor road (U2S) passing to the west of the properties of Airie and Achie and crossing the Queen's Way west of Waukmill. The route then diverges south and east to re-join the A762 south of Kenmure Castle. From there the route follows the A762 carriageway south before diverging west of Laurieston at Laurieston Hall. The route re-joins the A762 at Dinnance Farm and remains in the carriageway before diverging from A762 north of Ringford to cross the A75 west of Tarff Station. From there, the route broadly parallels the route of the A762, west of Bar Hill, through a mix of woodland and farmland, approaching Tongland substation from the south west.
UGC6C	33.15km	This route follows the same alignment as that of UGC6A with the exception of routeing at Ringford and into Tongland substation. The route diverges from the A762 at Glentarff, passing north and east of Ringford before turning south to cross the A75 following the wayleave of the existing R route. South of the A75, this route broadly stays with the route of the existing R route until Loch Hill. The cable route then sweeps west towards Castle Hill taking a more gradual incline into Tongland substation from the south west.

UGC6D	37.79km	This route leaves Glenlee substation following the minor road (U2S) before joining the A762 towards New Galloway. The route leaves the A762 south of the Coom Bridge before crossing the Water of Ken and joining the A713 at Boat Knowe. From there the route follows the carriageway of the A713 south before diverging north of Crossmichael where it heads eastwards, passing over relatively high ground of Rhone Hill and Culgruff Hill before descending south-eastwards and crossing the A713 and the River Dee. From here, the route heads south and west through Barnboard Wood near Balmaghie Bridge. Moving south the route passes through enclosed pasture/grazing fields before crossing the A75 near Upper Balannan Farm and heading south and approaching Tongland substation from the north.
UGC6E	38.31km	This route follows the same alignment as UGC6D with the exception of the approach into Tongland substation. This route diverges from that of UGC6D south of Bar Hill, skirting the boundary of Castle Hill wood, west of Tongland before approaching the substation from the south and west.
Preferred cable option		The environmental preference for this section was either of options UGC6D or UGC6E, both east of Loch Ken. Although these routes are both longer than the others, these options require the least tree felling, cross fewer flood risk zones and have the greatest potential to minimise long-term effects on tourism and recreation receptors than the route options west of Loch Ken. Following consideration of the points of engineering and environmental sensitivity, CCI recommended that route option **UGC6E** be taken forward as the preferred route option. This conclusion was predicated on cable route UGC6E being the preference for both the technical and environmental considerations. This recommendation was made in acknowledgement of the fact that cable route UGC6E wholly met the undergrounding objective for the UGC6 cable study which was to ensure consistency with the approach to routeing of overhead line i.e. a 'blank sheet' approach to identifying potential cable route options both east and west of Loch Ken.

Stage 1 Summary

At the conclusion of the stage 1 optioneering assessment, CCI recommended that the following options be taken forward to stage 2.

Table 5.9

Cable Section	Preferred Option	Route length	Figure Reference	CCI Report (Technical Appendix 1) Reference
Polquhanity to Kendoon	**UGC1B**	2.9km (2.37km cable and 0.53km OHL)	1.1B	4.1
Kendoon to Glenlee	**UGC2B**	8.43km (7.3km cable and 1.13 OHL)	1.2B	4.2
Queen's Way Crossing	**UGC3A**	4.2km	1.3A	4.3
Bennan, Slogarie & Laurieston	**UGC4C**	16.1km	1.4C	4.4
A75 Crossing	**UGC5A**	2.2km	1.5A	4.5
Glenlee to Tongland	**UGC6E**	38.31km	1.6E	4.6

6. Stage 2: Technical study

Overview

Following identification of preferred cable options during stage 1, CCI undertook a further detailed study to review points of engineering difficulty and opportunity for the preferred underground cable route sections. This study was undertaken via a range of desk based analyses and site visits.

The underground cable routes in the Technical Study Report ER 1033 RevA(see Appendix 2) include 15 minor route adjustments from the routes detailed in the CCI Optioneering Assessment. These modifications were as a result of information gained from site visits subsequent to the issue of the Stage 1 Optioneering Assessment. These changes have led to some variances in the preferred cable route lengths reported in the preceding section of this report.

In addition, ongoing wayleave discussions on the overhead line with landowners led to a change in the proposed overhead line alignment north of the A75, through UGC5[12]. This change is reflected in the cable and overhead line routes considered for UGC5 and these have been assessed in the Cable Route Appraisal Document by LUC which is Appendix 3 to the Technical Study Report ER 1033Rev A.

The environmental considerations for each CCI preferred undergrounding route section were again provided by Land Use Consultants Limited (LUC) and the estimated costs of undergrounding provided by SPEN. The subsequent technical, environmental and economic information provided by this study was then used as the basis for the comparative appraisal against the relevant overhead line sections in the Cable Route Appraisal Document.

Stage 2 Summary

It was found that each of the underground cable routes were assessed as constructible but that the routes:

- Contain a number of engineering difficulties some of which would require further detailed investigation or the use of available alternatives.
- Would require agreements from both landowners and statutory consultees on matters including the access and use of land (forestry, pastoral and arable) as well as existing track and road infrastructure (bridges, road, traffic controls, stone tracks, footpath and recreational areas).
- Would require the installation of cable termination compounds or OHL terminal towers capable of supporting cable terminations.

In addition, transmitting electricity via underground cables, can cause significant changes to transmission system voltage. Such changes can lead to a loss in power transfer potentially causing damage to equipment and poor quality of supply on the network. These issues can be mitigated by installing 'reactive compensation' (in the form of 'shunt reactors') at certain substations on the network to reduce or negate these effects.

[12] Further detail on this change is provided in Section 6.12 of Appendix 2.

On that basis, SPEN's system design team undertook separate reactive compensation studies for each of the six identified cable routes to assess which might require such mitigation, including where this would need to be sited on the existing network.

The study concluded that reactive compensation would be required for UGC2, UGC4 and UGC6 and the associated environmental, economic and technical appraisals[13] for the underground cable routes in each of these sections include for the provision of reactive compensation[14].

The projected costs of the undergrounding and overhead line construction were provided by SPEN and are summarised in table 6.1 below.

Table 6.1 Summary of projected costs (based on data from SPEN)

Route	UGC Cost ('000)	UGC Cost per km ('000)	OHL Cost ('000)	OHL Cost per km ('000)	Cost Ratio[15]
UGC1B	£17, 649	£7, 354	£4, 550	£1, 521	**3.88**
UGC2B	£47, 725	£6,628	£9, 530	£1, 202	**5.01**
UGC3A	£15,221	£3, 515	£4,496	£1,210	**3.38**
UGC4C	£53, 367	£3, 335	£13, 434	£930	**3.97**
UGC5A	£10, 789	£4, 904	£2, 167	£780	**4.98**
UGC6E	£126, 973	£3, 378	£31, 011	£920	**4.09**

7. Stage 3: Appraisal of underground cable vs overhead line

On completion of CCI's stage 2 technical report, an appraisal of the cable options against the proposed KTR OHL route alignments was undertaken by SPEN. This appraisal has drawn on the technical and environmental inputs, provided by CCI and LUC respectively, from the stage 1 and 2 studies and economic inputs from SPEN's in house engineering design teams.

This appraisal was undertaken against SPEN's statutory and licence duties as the holder of a transmission licence s, which is to say, the final solution for each of the six sections being considered must be technically efficient and economically viable, balancing effects on the environment and people. The final conclusions on each section are therefore written with these obligations in mind.

The Stage 3 comparative appraisal tables detailing the technical, economic and environmental issues for both the underground cable and OHL options can be found in Appendix 3.

[13] See Appendix 3
[14] Further details on reactive compensation can be found in section 6.3 of the Technical Study (Appendix 2).
[15] The cost ratio is the ratio between the UGC Cost and the OHL Cost (i.e. the multiple by which the UGC Cost exceeds the OHL Cost)

Table 7.2 Summary of SPEN conclusions

Section	Tower No's	Conclusion
UGC1 Polquhanity to Kendoon	N230 – PK10	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape and visual receptors, residential amenity, cultural heritage features and forest and woodland resource. However, very localised significant landscape and visual effects would arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. The appraisal also found that the UGC1B would be technically feasible although specific difficulties would be encountered in relation to the complexities of undertaking a continuous cable excavation through areas of peat and shallow bedrock, traffic management and lane closures on the A713 and crossing of existing underground services. The costs appraisal outlined above shows that an underground cable in this section (including the cost for 0.53km of overhead line at Kendoon) would be 3.88 times greater than the proposed overhead line route with a projected cable cost being £17.65M and overhead line cost of £4.55M with an overall projected difference in cost of **£13.1M**. **In consideration of the above, SPEN's preference is to progress with an overhead line option between Polquhanity and Kendoon. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC1B does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: *"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."*

		SPEN believe that, proceedingwith an overhead line solution for the Polquhanity to Kendoon section, is a conclusion which remains consistent with the overall KTR Project routeing objective.
UGC2 Kendoon to Glenlee	PK10 – PK33	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape and visual receptors, residential amenity and cultural heritage features. However, very localised significant landscape and visual effects would arise from the introduction of a sealing end compound and terminal tower to facilitate the transition between OHL and UGC. The appraisal also found that the UGC 2 would be technically feasible although specific difficulties might be encountered in relation to water crossings. Traffic management and lane closures on the A713 and A762 would also be required. The costs appraisal outlined above shows that an underground cable (including the cost for 1.13km of overhead line into Glenlee) in this section would be 5.01 times greater than the proposed overhead line route with a projected cable cost being £47.72M and overhead line cost of £9.53M with an overall projected difference in cost of **£38.19M**. **In consideration of the above, SPEN's preference is to progress with an overhead line option between Kendoon and Glenlee. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC2B does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: "To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."

		SPEN believe that proceeding with an overhead line solution for the Glenlee to Kendoon section, is a conclusion which remains consistent with the overall KTR routeing objective.
UGC3 Queen's Way Crossing	GT08 – GT21	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape and visual receptors and forestry. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling adjacent to the Raiders road to Kenmuir Link Core Path would also be required. The appraisal also found that the UGC 3 would be technically feasible although specific difficulties would be encountered in relation to water crossings, topography and areas of peat and shallow bedrock. Traffic management and lane closures on the A712 would also be required. The costs appraisal outlined above shows that an underground cable in this section would be 3.38 times greater than the proposed overhead line route with a projected cable cost being £15.22M and overhead line cost of £4.5M with an overall projected difference in cost of **£10.72M**. **In consideration of the above, SPEN's preference is to progress with an overhead line option across the Queen's Way crossing. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC3A does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: "To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it." SPEN believe that proceeding with an overhead line solution across the Queen's Way, is a conclusion which remains consistent with the overall KTR routeing objective.

UGC4 Bennan, Slogarie & Laurieston Forests	GT25 – GT78	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape and visual receptors, residential amenity surrounding cultural heritage features and forestry. However, long-term significant visual effects on views and visual amenity will still be experienced by recreational receptors, while substantial felling where the UGC parallels adjacent to the Raiders Road Forest Drive/Raiders Road to Mossdale Core Path between Upper Gairloch and Stroan Loch would also be required. The appraisal also found that the UGC 4 would be technically feasible although specific difficulties might be encountered in relation to water crossings, topography and areas of peat and shallow bedrock. Traffic management and lane closures on the A762 would also be required. The costs appraisal outlined above shows that an underground cable in this section would be 3.97 times greater than the proposed overhead line route with the projected cable cost being £53.37M and overhead line cost of £13.43M with an overall projected difference in cost of **£39.93M**. **In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option through the Bennan, Slogarie and Laurieston forests. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC4C does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: "To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it." SPEN believe that proceeding with an overhead line solution through the Bennan, Slogarie and Laurieston forests, is a conclusion which remains consistent with the overall KTR routeing objective.

UGC5 A75 Crossing	GT97 – GT104	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape and visual receptors and residential amenity. However, long-term significant visual effects on views and visual amenity would still arise from the installation of cable sealing towers. The appraisal also found that the UGC 5 would be technically feasible although specific difficulties might be encountered in relation to shallow bedrock. Traffic management and lane closures on the A75 and would also be required. The costs appraisal outlined above shows that an underground cable in this section would be 4.98 times greater than the proposed overhead line route with the projected cable cost being £10.78M and overhead line cost of £2.16M with an overall projected difference in cost of **£8.62M**. **In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option across the A75. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC5A does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: "To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it." SPEN believe that proceeding with an overhead line solution across the A75, is a conclusion which remains consistent with the overall KTR routeing objective.

UGC6 Glenlee to Tongland	GT001 – GT120	The appraisal found that the overall environmental benefits that would be experienced from an underground cable, in comparison with an overhead line, would be a reduction in effects on landscape, visual and residential amenity the UGC would have a lesser impact on surrounding cultural heritage features. Furthermore, substantially less felling will be required for the UGC than the OHL. The appraisal also found that the UGC 6 would be technically feasible although specific difficulties might be encountered in relation to water course crossings, crossing of existing high pressure gas pipelines (in the vicinity of the A75) and shallow bedrock. Traffic management and lane closures on the public road network would also be required and works through the settlements of Glenlee, Crossmichael and Townhead of Greenlaw would also cause significant disruption due to road narrowing, loss of parking and construction noise. The costs appraisal outlined above shows that an underground cable in this section would be 4.09 times greater than the proposed overhead line route with the projected cable cost being £126.97M and overhead line cost of £31.01M with an overall projected difference in cost of **£95.96M**. **In consideration of the above, SPEN's preference, by virtue of the economic impact, is to progress with an overhead line option between Glenlee and Tongland substations. It is acknowledged by SPEN that the underground option is technically feasible and, on balance, environmentally preferable. Nevertheless UGC6E does not offer sufficient environmental advantages to justify the substantial increase in costs as compared to the OHL section. The underground option would be inherently less efficient and less economic than the OHL section. SPEN's conclusion reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between the overhead line and underground cable options considered in this section.** Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is: "To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it." SPEN believe that proceeding with an overhead line solution between Glenlee and Tongland substations is a conclusion which remains consistent with the overall KTR routeing objective.

Final Conclusion

This assessment has been carried out in order to allow a transparent, detailed and comprehensive comparison of underground and overhead options. It has been carried out in a manner which reflects SPEN's statutory and license duties, considering the technical, economic and broad environmental differences between an overhead line and underground cable.

This assessment has been carried out across six distinct sections with the results summarised above and reported in detail in Appendices 1-3 below. As can be seen, the balance involved in selecting an underground cable route is much more complex than that for an overhead line due to the need to strike a balance not only between underground cable system technical requirements, environmental and financial considerations, but also with the length of cable route which is directly related to both cost and disturbance. With underground cable, the cost is the dominant consideration.

In considering whether electric lines should be placed underground to obtain the benefits of reductions in landscape and visual or other impacts, there is a requirement on SPEN to balance those reductions against the costs (economic), other environmental impacts and the technical challenges of undergrounding.

In each section, SPEN's preference is to progress with an overhead line option. It is acknowledged by SPEN that the underground option is, in each case, technically feasible and, on balance, environmentally preferable having regard to landscape and visual as well as forestry impacts. Nevertheless, the environmental benefits must also be balanced against the additional costs involved.

The comparison of costs between each cable and overhead line section clearly demonstrates a significant economic differential. That differential (between cable and overhead line) ranges from a multiple of 3.38 to 5.01 times the overall cost in each section. The overall costs of the underground cable options compared to the equivalent section of overhead line range from £8.62M to £95.96M more expensive.

SPEN does not consider that the environmental benefits of undergrounding any of the cable sections is outweighed by the substantial additional costs involved. In conclusion, SPEN does not consider that pursuing any of the underground cable options would be consistent with the statutory and licence obligations to which it is subject.

Furthermore, in relation to SPEN's approach to routeing of major electrical infrastructure and the specific routeing objective set for the KTR Project which is:

"To identify a technically feasible and economically viable route for a continuous 132kV overhead line connection supported on lattice steel towers from Polquhanity to Kendoon, from Kendoon to Glenlee, and from Glenlee to Tongland. The Project is also required to identify new 132kV overhead line connections supported on trident wood poles from Carsfad to Kendoon, and from Earlstoun to Glenlee. The routes should, on balance, cause the least disturbance to the environment and the people who live, work and enjoy recreation within it."

SPEN believes that proceeding with an overhead line solution for each of the six sections, is a conclusion which remains consistent with the overall KTR routeing objective.

On the basis of the conclusions set out above, SPEN intends to proceed with an overhead line option for each of the connections which collectively make up the KTR Project.