

## **Glenlee Substation**

Appraisal of Alternative Substation Sites

October 2018

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SP Energy Networks October 2018

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## 1. Background

- 1.1. Since 2015 Scottish Power Energy Networks (SPEN) has been consulting communities about its plans to modernise and reinforce the existing 132,000 volt (132kV) electricity network between Kendoon and Tongland, known as the Kendoon to Tongland Reinforcement (KTR) Project.
- 1.2. As part of these proposals, SPEN is also bringing forward separate plans to extend Glenlee Substation to accommodate the extra equipment we need to connect and operate the new overhead lines proposed as part of the KTR Project.
- 1.3. Although part of the KTR Project, the Glenlee Substation work has to be completed in advance of the overhead line works in order to meet the limited outage dates available on the transmission system for connecting the proposed overhead lines, so SPEN needs to make a planning application for the substation works to Dumfries and Galloway Council that is separate from our application for the KTR Project.

## 2. Consultation

- 2.1. Consultation is a fundamental part of the development of any project, and SPEN has undertaken extensive consultation with local communities on the proposals for Glenlee as part of the KTR Project, with feedback taken into consideration when designing the substation extension.
- 2.2. SPEN held a separate consultation in March and April 2018 specifically on our plans for Glenlee substation, to ensure that local people understood and had the opportunity to comment on the proposals.
- 2.3. The Glenlee consultation in March and April 2018 ran separately from the wider KTR third round consultation, which focused on detailed routes for the overhead lines that form the KTR Project and which took place from November 2017 to January 2018. Previous rounds of consultation had taken place in 2016 (on proposed routes for the lines) and in 2015 (on the need for the project).
- 2.4. SPEN is currently reviewing the feedback received in relation to the KTR third round consultation and intends to publish a separate summary of feedback report detailing our responses in late 2018.
- 2.5. Any issues relating to overhead lines and routeing raised during the Glenlee substation consultation, such as undergrounding and overhead line entries to substations, will be considered and addressed as part of the KTR summary of feedback report.

## 3. Glenlee consultation feedback

- 3.1. During the Glenlee consultation we received feedback from key stakeholders, communities and interested individuals on a range of issues; in particular regarding the siting and design of the substation.
- 3.2. Following this feedback, SPEN has undertaken a full review and evaluation of potential options before drawing up final proposals for which planning permission will be sought. All potential options were considered against SPEN's statutory obligations as a transmission licence holder under the Electricity Act, which require us to develop the transmission system in an economic and efficient manner as well as considering and mitigating impacts on people and the environment.
- 3.3. The purpose of this document is to respond specifically to the question of whether the proposed substation extension could be moved to the north west of the Glenlee Power Station building, and to set out the next steps in the process. The intention is that this will inform future discussions with stakeholders and communities in advance of a planning application being made to Dumfries and Galloway Council.

# 4. SPEN's Statutory and Licence Duties and the role of Ofgem

- 4.1. As a transmission licence holder for southern Scotland, 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.
- 4.2. 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 overhead transmission lines and other transmission works:
- 4.3. "(a) to have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and,
- 4.4. (b) to do what it reasonably can to mitigate any effects which the proposals would have on the natural beauty of the countryside or any such flora, fauna, features, sites, buildings or objects."
- 4.5. In terms of its electricity transmission licence, 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 or permissions. Ofgem (the Office of 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 undertaking works at Glenlee will be placed on electricity consumers throughout Great Britain. As a result, the financial costs of all options for alternative substation sites have to be evaluated against the obligations above, to establish whether they can be justified.

4.6. In considering these issues, SPEN's overall objective for the siting of the substation at Glenlee is to identify a technically feasible and economically viable site which causes, on balance, the least disturbance to the environment and the people who live, work and enjoy recreation within it.

## 5. Substation Options

5.1. The initial suggestion from the community was to move the substation extension element to the opposite side of the Glenlee Power Station and penstock pipe, retaining the existing substation in the same location adjacent to the properties of Rannoch, Tummel and Carville. This was suggested as a means to reduce potential impact on residents during both the construction and future operation of the substation. However, following initial consideration of this feedback, SPEN decided to develop additional options, including moving the entire substation. On this basis, SPEN identified four potential substation options for Glenlee:

Option 1: Extension of the existing substation site (original option);

*Option 2*: Retain the existing substation but move the proposed extension to the opposite side of the Glenlee Power Station;

*Option 3*: Move entire substation (proposed and existing) to the opposite side of the Glenlee Power Station as an air insulated substation (AIS); and

*Option 4*: Move entire substation (proposed and existing) to the opposite side of the Glenlee Power Station as a gas insulated substation (GIS).

5.2. The following provides a more detailed description of each option which has been considered.

#### 5.3. **Option** 1

This option would involve extending the existing substation directly adjacent to the southwest. The development footprint would include gantries connecting to the first terminal tower on the proposed realignment of the existing BG Route overhead line route as part of the wider KTR Project. The development footprint for the substation extension is approximately 0.69 hectares (including the access and changes to ground levels). The existing control building would require a minor extension. Option 1 is illustrated in Figure 1.

#### 5.4. **Option 2**

This option would involve locating the proposed substation extension behind the existing Glenlee Power Station as an entirely new substation site. The development footprint for the substation extension is approximately 1.83 hectares (including the access and changes to ground levels). The layout of Option 2 is illustrated in Figure 2.

#### 5.5. **Option** 3

This option would involve moving the whole substation (i.e. existing substation plus new extension) as an Air Insulated Substation (with most equipment outdoors, as existing substation). This option would allow the existing site to be demolished. The development footprint for the substation extension is approximately 1.78 hectares (including the access and changes to ground levels). The layout of Option 3 is illustrated in Figure 3.

#### 5.6. **Option 4**

This option would involve moving the whole substation as a Gas Insulated Substation (with the GIS switchgear contained inside a building). This option would allow the existing site to be demolished. The development footprint for the substation extension is approximately 1.1 hectares (including the access and changes to ground levels). The layout of Option 4 is illustrated in Figure 4.

## 6. Appraisal of Options

6.1. SPEN has undertaken a full appraisal of each of the four options described in section 5 of this document. In light of SPEN's statutory and licence obligations, each option has been appraised against the following criteria:

#### Economic

- Overall construction cost of the option taking into account expected civils, plant, equipment and labour costs (based on 2018 estimates)

#### **Technical**

- Size of development footprint;
- Feasibility of constructing on the site; and
- Risk to supplies to existing customers during construction and commissioning of the extended/new substation

#### Environmental

- Landscape and visual amenity;
- Ecology;
- Ornithology;
- Cultural heritage;
- Hydrology;
- Construction noise and vibration and operational noise;
- Peat; and
- Traffic and transport.
- 6.2. The detailed appraisal of these options is captured in the tables in appendix 1 of this document. Where relevant, commentary is provided on how each alternative option compares with the original option (Option 1).

## 7. Conclusion

- 7.1. Following consideration of the technical, economic and environmental factors relating to each of the four options, <u>SPEN has concluded that the option to be taken forward is</u> <u>Option 1</u>. This decision has been made on the following basis:
  - All options are technically feasible and will achieve the same operational goal of connecting the overhead lines being proposed as part of the KTR Project.
  - Options 2, 3 and 4 are not considered to be economic or efficient when evaluated against SPEN's statutory and licence obligations as each of these options is at least double the cost in comparison with Option 1.
  - Option 2 is not efficient or coordinated, requiring construction of a new substation extension less than 200m from the existing site and increasing risks to customers fed from Glenlee during construction of the extension.
  - Options 3 and 4 are not efficient in that they would involve the demolition of an existing substation site with an expected remaining asset life of 20-30 years. Due to operational issues requiring the existing substation to be retained while the new substation is being constructed, it is not considered feasible to utilise existing plant and equipment on the new substation site.
  - Options 2, 3 and 4 extend the presence and influence of transmission electrical infrastructure beyond that of the existing substation and the Glenlee Power Station into an area of currently undeveloped farmland with mature trees on the boundary.
  - Options 2, 3 and 4 will likely result in re-alignment of the existing BG overhead line route and proposed Glenlee to Tongland routes with the towers having to pass over the higher ground formed by the north-eastern shoulder of Glenlee Hill to the west, south-west of the penstock. The likely result is that these towers would be visible over a more extensive area, including views from St John's Town of Dalry and locations on the Southern Upland Way, and leading to potentially greater landscape and visual effects when compared with Option 1.
  - Due to their elevated nature and topography, options 2, 3 and 4 will result in extensive earthworks to construct the substation platform, leading to a further increase in vehicle movements during the construction period.
  - Options 2, 3 and 4 vary in development footprint size being between 1.5 and 2.5 times larger than option 1 and will therefore require a greater amount of materials to construct the substation platform and compound, leading to a further increase in vehicle movements during the construction period.
  - Options 2, 3 and 4 (the new sites separate from the existing substation) will create a greater visual impact to the surrounding area in comparison to Option 1.
- 7.2. It is acknowledged that Option 1 will give rise to greater impacts on residents during construction as a result of construction noise and vibration in comparison with options 2, 3 and 4. These impacts will be limited to during the main earthworks and formation of the substation extension platform.

- 7.3. In relation to Option 1, the extension site will require a substantial amount of earthworks to enable construction of the substation platform, but will also provide opportunities to screen much of the substation infrastructure in distant and elevated views from the Glenkens Valley, and from the nearby properties of Orrin, Garry, Maree, Navar and Tarbert. The substation infrastructure will be lower than neighbouring properties and their curtilages, with opportunities for further mitigation measures (landscape mitigation planting) around the outer extents of the substation and surrounding earthworks to further reduce its impact on views from nearby properties.
- 7.4. Considering the above issues in the context of SPEN's statutory and licence duties and obligations, SPEN considers that Option 1 (an extension to the existing substation site) is the most technically feasible, economic and efficient option which causes, on balance, least disturbance to the environment and people.
- 7.5. However, we recognise that Option 1 will cause disturbance to residents and landowners, and we are committed to working with them to explore further opportunities to mitigate the potential effects during the construction and operational phases of the site.

## 8. Next Steps

- 8.1. SPEN understands the importance of consultation and that residents, the wider community and key stakeholders will wish to discuss the conclusions of this appraisal process in further detail. Therefore, in advance of a planning application being made, SPEN will hold a further drop-in event at the CatStrand centre in New Galloway where members of the project team will be available to discuss these proposals and explore further mitigation opportunities.
- 8.2. It is intended to hold this event during autumn 2018 with the planning application to be made to Dumfries and Galloway council during early 2019.
- 8.3. The planning application will be supported by:
  - A full Environmental Impact Assessment Report (EIAR) detailing the environmental assessment of the site; and
  - Pre-Application Consultation (PAC) report setting out the feedback received during the pre-application consultation and SPEN's responses to this feedback, including where this has influenced the scope and design of the proposals.
- 8.4. SPEN will publicise the application on our website and send an update to people who have signed up to receive email from us to let them know it has been submitted. You can sign up for emails by sending a request to dgsr@communityrelations.co.uk.
- 8.5. Following submission of the planning application, Dumfries and Galloway Council will hold its own statutory consultation which will offer a further opportunity for key stakeholders, residents and the wider community to make their views known and have these taken account of in the decision making process.

Technical, Economic and Environmental Review of Glenlee Substation Alternative Options

## Table 1: Technical, Economic and Environmental Review of Glenlee Substation Alternative Options

Criteria	Option 1	Option 2 – Alternative substation extension location	Option 3 – Replacement of entire substation (proposed and existing) with an air insulated substation (AIS)
Technical Considerations			
Size of development footprint	The development footprint for the substation extension (including the areas of cut and fill and access track) is approximately 0.69 hectares. No new control building would be required.	The development footprint for this option (including the areas of cut and fill and access track) is approximately 1.83 hectares, including a new control building.	The development footprint for this option (including the areas of cut and fill and access track) is approximately 1.78 hectares, including a new control building. It is noted that this option has a smaller footprint than Option 2. This is due to the fact that a similar amount of 132kV circuit breaker (CB) bays [9-off] are required. Both options also require a new Control Building and access road, and similar civils/ground preparation works and are therefore of a similar size.
Feasibility and Risk to Supply to Customers	<ul> <li>This option is technically feasible and minimises risks to supplies to existing customers. The existing Glenlee site supplies approximately 18,000 customers in this area. Extending the existing site is the most effective way to manage required outages on the existing system during construction and tie in new connections for Newton Stewart / Glenluce, Earlstoun, Tongland and New Cumnock, thereby reducing risk to these customers.</li> <li>The existing substation was refurbished 20 years ago and is not due to be replaced/refurbished for a further 20-30 years. This option allows the existing site plant and equipment to be maintained in use.</li> </ul>	<ul> <li>This option is technically feasible. However, it presents a significant risk in terms of how construction outages are managed and staged to tie in new connections for Newton Stewart / Glenluce, Earlstoun, Tongland and New Cumnock.</li> <li>This option would also require 2 additional overhead line connections to the existing Glenlee site over the penstock pipe.</li> <li>The existing substation was refurbished 20 years ago and is not due to be replaced/refurbished for a further 20-30 years. This option allows the existing site plant and equipment to be maintained in use, in addition to the new substation extension site.</li> <li>This would require the construction of a new substation extension site less than 200m from the existing site.</li> </ul>	This option is technically feasible. However, it presents a lesser risk compared to option 2 in terms of how construction outages are managed and staged to tie in new connections for Newton Stewart / Glenluce, Earlstoun, Tongland and New Cumnock. This option would involve 2 new overhead lines entering the new substation site from the south (from the top of the hill). This option would involve the demolition of the existing substation site which still has a 20-30 year operational lifetime. It is not economically efficient or operationally acceptable to reuse existing plant and switchgear and associated gantries on the construction of an alternative site while trying to maintain and operate the existing substation site.
Economic Considerations			
Overall construction costs	Overall cost of construction work to extend the existing site is £12.0m (based on 2018 estimate of plant and civils costs). This is the most efficient and coordinated option.	Overall cost of Option 2 is £24.7m (based on 2018 estimate of plant and civils costs). The additional costs are attributed to the substantial site footprint required to accommodate the new AIS switchgear and increased civils costs due to difference in slope gradients across the site. As this is a new substation site there would also be a requirement for a new control building to manage the substation during operations and also a requirement for a new access road. Additional costs would be incurred in re-routing Tongland 1 / 2 and NS/Glenluce 1 / 2 OHL circuits into the new substation site, and also for 2 new overhead line connections between the new and existing Glenlee substation sites.	Overall cost of Option 3 is £26.7m (based on 2018 estimate of plant and civils costs). The additional costs are attributed to the substantial site footprint required to accommodate the new AIS switchgear and also increased civils costs due to difference in slope gradients across the site. As this is a new substation site there would also be a requirement for a new control building to manage the substation during operations and also a requirement for a new access road. Additional costs would be incurred in re-routing Tongland 1 / 2 and NS/Glenluce 1 / 2 OHL circuits into the new substation site, and also for additional 11kV and 132kV cabling works and a new 132kV/11kV Transformer.
Environmental			
Ecology	The majority of the land upon which this option would be located is improved grassland which is common and widespread and generally low value for wildlife. No notable flora species were noted during the Phase 1 Habitat Survey. Some trees with bat roost potential will require to be removed for the construction and operation of this option.	The majority of the land upon which these options would be located Phase 1 Habitat Survey. The only ecological features of note in the area of the development re including bats. There would be no need for a diversion to the watercourse that flows	is improved grassland which is common and widespread and generally lo elate to bats, as these options extends to an area of broadleaved woodlan s under the existing substation.
	This option will require a diversion to an existing watercourse. Electrofishing surveys confirmed that no fish or crayfish are present.		
Ornithology	The site and surrounding area are overall consider	ed to be of low value for habitats and protected species. No ornithologi	ical species of note were identified during surveys of these areas.
Cultural Heritage	The development footprint for the substation extension, including the proposed infrastructure associated with this option (landing gantry 2 and the working area for R-BG-102), falls within an area where metal working debris (slag) has previously been recorded as having been exposed and washed out of the bed and banks of a small stream in the 1970s. This information suggests the possible presence of a metal working site in this field. Mitigation in the form of test-pitting or small trial trenching within the development footprint would determine	The proposed infrastructure, (new intermediate trident pole line between the existing substation and the proposed substation) falls within an area where metal working debris (slag) has previously been recorded as having been exposed and washed out of the bed and banks of a small stream in the 1970s. This information suggests the possible presence of a metal working site in this field. Mitigation in the form of test-pitting or small trial trenching within the development footprint would determine whether a metal working site is preserved and would also be likely to recover some dating evidence for the site. The Glenlee Power Station and Glenlee Power Station Bridge are Category B Listed Buildings. However, it is considered that there will	There are no previously recorded heritage constraints within the footp The Glenlee Power Station and Glenlee Power Station Bridge are Catego adverse effect on the setting of the listed buildings identified given tha The alignment of the proposed Glenlee-Tongland OHL and the realignm likely have to pass over the higher ground formed by the north-eastern before deviating towards the existing alignment of the Glenluce (BG rou towers. As a consequence, the new OHL alignments would potentially H Park Non-Inventory Designed Landscape (NIDL) and its associated Listee (LB9737)) which at its closest lies c.60m to the southeast of the propose wider landscape surroundings and may have an effect on the setting of

## Option 4 – Replacement of entire substation (proposed and existing) with a gas insulated substation (GIS)

The development footprint for this option (including the areas of cut and fill and access track) is approximately 1.1 hectares, including a new GIS Switchgear Control Building.

This option is technically feasible. However it presents a lesser risk compared to Option 2 in terms of how construction outages are managed and staged to tie in new connections for Newton Stewart / Glenluce, Earlstoun, Tongland and New Cumnock.

This option would involve 2 new overhead lines entering the new substation site from the south (from the top of the hill).

This option would involve the demolition of the existing substation site which still has a 20-30 year operational life. As this proposal is a GIS, much of the existing plant could not be re-utilised. Generally, it is not economically efficient or operationally acceptable to reuse existing plant and switchgear and associated gantries on the construction of an alternative site while trying to maintain and operate the existing substation site.

**Overall cost of Option 4 is £28.5m** (based on 2018 estimate of plant and civils costs).

The additional costs are attributed to the large site footprint required to accommodate the new GIS switchgear building, OHL Terminal Towers, 132/11kV Transformer and also increased civils costs due to difference in slope gradients across site. There would also be a requirement for a new access road. Gas insulated switchgear is more expensive to purchase and install than AIS, however it can be contained within a building requiring a smaller footprint so estimated civils costs are reduced.

Additional costs would be incurred in re-routing Tongland 1 / 2 and NS/Glenluce 1 / 2 OHL circuits into the new substation site, and also for additional 11kV and 132kV cabling works and a new 132kV/11kV Transformer.

The costs also include the demolition of the existing substation site.

v value for wildlife. No notable flora species were noted during the

and there is therefore potential for effects on protected species,

#### int of options 3 and 4.

y B Listed Buildings. However, it is considered that there will be no t these are an integral part of the existing substation.

ent of the existing Glenlee-Glenluce (BG Route) connections would shoulder of Glenlee Hill to the west southwest of the penstock ite at c. tower 098-099). This is likely to result in skylining of the be more visible than the current alignment when seen from Glenlee d Buildings (including Category B Listed Glenlee Park Country House d development. The more visible OHL alignments would change the the Glenlee Park NIDL and its associated listed buildings.

Criteria	Option 1	Option 2 – Alternative substation extension location	Option 3 – Replacement of entire substation (proposed and	0
			existing) with an air insulated substation (AIS)	e
	whether a metal working site is preserved and would also be likely to recover some dating	be no adverse effect on the setting of the listed buildings given that these are an integral part of the existing substation.		
	evidence for the site. The Glenlee Power Station and Glenlee Power Station Bridge are Category B Listed Buildings. However, it is considered that there will be no adverse effect on the setting of the listed buildings given that these are an integral part of the existing substation. To mitigate the visual impact of the proposals on nearby residential properties to the south (see below), the substation extension will be situated at a lower elevation than the nearby properties to facilitate opportunities for landscape mitigation planting around the outer extents of the substation. A consequence of the landscape mitigation planting is that the substation and the proposed R-BG-102 tower would be mostly screened from view from within Glenlee Park Non-Inventory Designed Landscape (NIDL) and from associated listed buildings, including Category B Listed Glenlee Park Country House (LB9737), to the southeast of the proposed development. As a result it is likely that any impact on the setting of Glenlee Park NIDL and its associated listed buildings from the proposals would be minimal.	The alignment of the proposed Glenlee-Tongland OHL and the realignment of the existing Glenlee-Glenluce (BG Route) connections would likely have to pass over the higher ground formed by the north-eastern shoulder of Glenlee Hill to the west southwest of the penstock before deviating towards the existing alignment of the Glenluce (BG route at c. tower 098-099). This is likely to result in skylining of the towers. As a consequence, the new OHL alignments would potentially be more visible than the current alignment when seen from Glenlee Park Non-Inventory Designed Landscape (NIDL) and its associated Listed Buildings (including Category B Listed Glenlee Park Country House (LB9737)) which at its closest lies c.60m to the southeast of the proposed development. The more visible OHL alignments would change the wider landscape surroundings and may have an effect on the setting of the Glenlee Park NIDL and its associated listed buildings.		
Noise	Construction activities are predicted to result in noise levels above recommended thresholds at some of the adjacent properties during certain periods of the construction programme. To mitigate this noise, a 2 metre barrier is proposed to be installed between the site and the residential properties which would provide acoustic screening, bringing all activities within required thresholds at the receiver locations. Noise levels from vehicle movements adjacent to the nearest noises sensitive properties would also be within the set threshold. The extension to the substation does not require any new transformers therefore there will be no	Given the increased distance from the closest residential properties, it is likely that this option would result in slightly lower noise effects during construction than Option 1; therefore installation of noise screens would not be required. Noise levels from vehicle movements at the nearest noise sensitive properties would be within the set threshold. Under this option, there would not be a transformer located within the new substation site (transformer would remain at the existing substation site).	Given the increased distance from the closest residential properties, it is likely that this option would result in slightly lower noise effects during construction than Option 1, therefore removing the requirement for the installation of noise screens. Noise levels from vehicle movements at the nearest noises sensitive properties would be within the set threshold. In regards to operational noise, the existing transformer would not be required and will be taken out of service. A new AIS transformer would be installed at the site therefore moving all operational plant further away from residential properties. This would potentially decrease operational noise when compared to the current noise baseline.	G it re N p In tr su p co
Landscape and Visual Amenity	change in background noise once operational. Substation Siting Implications:	Substation Siting Implications:	Substation Siting Implications:	SI
Landscape and Visual Amenity	Substation Siting Implications: The site is located wholly within Galloway Hills Regional Scenic Area (RSA) and within Upper Dale (Valley) LCT (Upper Glenkens) which is judged to have a Medium capacity to accommodate both substation and overhead transmission infrastructure. This option will extend the existing Glenlee substation footprint to the south, approximately doubling the overall footprint, but will contain the presence of transmission infrastructure one side of the Glenlee Power Station penstock and not substantially increase its influence over a much wider area. The extension site will require substantial cut and fill to facilitate construction of the substation platform, however as a consequence opportunities will exist to effectively screen much of the substation infrastructure in distant and elevated views from the Glenkens Valley, and from the nearby properties of Orrin, Garry, Maree, Navar and Tarbert. As the substation infrastructure will be situated at a lower elevation to the properties and their curtilages, with opportunities for further mitigation measures (landscape mitigation planting) to be implemented around the outer extents of the substation and surrounding earthworks to further reduce its influence in views from nearby properties.	<ul> <li>Substation Siting Implications:</li> <li>The site is located wholly within Galloway Hills Regional Scenic Area (RSA) and wholly within Upper Dale (Valley) LCT (Upper Glenkens) which is judged to have a Medium capacity to accommodate both substation and overhead transmission infrastructure.</li> <li>This option extends the presence and influence of electrical infrastructure beyond that of the existing substation and the Glenlee Power Station into an area of currently undeveloped farmland with mature boundary and individual field trees.</li> <li>The substation extension footprint is c.5-6 times larger than that of Option 1, and will require a substantial extent of cut and fill and loss of existing mature trees to the north of the penstock.</li> <li>The location occupies a more elevated position to the north of the Glenlee Power Station and penstock, and as a consequence will be more widely visible and perceptible from elevated locations such as Mulloch Hill and Waterside Hill on the Southern Upland Way (SUW), and other elevated locations in the settlement of St. John's Town of Dalry.</li> <li>As a consequence, the site and its immediate surroundings offer less opportunity for the implementation of landscape mitigation planting to assimilate the substation in longer distance views.</li> <li>This option avoids the presence of additional infrastructure in close proximity to the residential properties of Orrin, Garry, Maree, Navar and Tarbert, with views of the proposed new substation infrastructure experienced at a greater distance of c.200-250m, beyond the penstock and partial screened/filtered by existing mature deciduous trees south-east of the penstock.</li> </ul>	<ul> <li>Substation Siting Implications:</li> <li>The site located is wholly within Galloway Hills Regional Scenic Area (RSA) and wholly within Upper Dale (Valley) LCT (Upper Glenkens) which is judged to have a Medium capacity to accommodate both substation and overhead transmission infrastructure.</li> <li>This option extends the presence and influence of transmission infrastructure beyond that of the existing substation and the Glenlee Power Station into an area of currently undeveloped farmland with mature boundary and individual field trees.</li> <li>Substation extension footprint is c.5-6 times larger than that of the proposed Planning Application Option, and will require a substantial extent of cut and fill and loss of existing mature trees to the north of the penstock.</li> <li>The alternative location occupies a more elevated position to the north of the Glenlee Power Station and penstock, and as a consequence will be more widely visible and perceptible from elevated locations such as Mulloch Hill and Waterside Hill on the Southern Upland Way (SUW), and other elevated locations in the settlement of St. John's Town of Dalry.</li> <li>As a consequence, the site and its immediate surroundings offer less opportunity for the implementation of landscape mitigation planting to assimilate the substation in longer distance views.</li> <li>This option removes the presence of additional infrastructure in close proximity to the residential properties of Orrin, Garry, Maree, Navar and Tarbert, with views of the proposed substation infrastructure experienced at a greater distance of c.200-250m, beyond the penstock and partial screened/filtered by existing mature deciduous trees south-east of the penstock.</li> </ul>	Si TIRWS TINGE SPECTOTION TO THE SOLUTION TO SIZE THE SECTION

## ption 4 – Replacement of entire substation (proposed and xisting) with a gas insulated substation (GIS)

iven the increased distance from the closest residential properties, t is likely that this option would result in slightly lower noise effects luring construction than Option 1, therefore removing the equirement for the installation of noise screens.

loise levels from vehicle movements at the nearest noises sensitive properties would be within the set threshold.

n regards to operational noise, under this option, a new GIS ransformer would be required. As with Option 3, this takes the ubstation further away from residential properties so there is botential for this option to decrease operational noise when ompared to the current noise baseline.

#### ubstation Siting Implications:

The site is located wholly within Galloway Hills Regional Scenic Area RSA) and wholly within Upper Dale (Valley) LCT (Upper Glenkens) which is judged to have a Medium capacity to accommodate both substation and overhead transmission infrastructure.

his option extends the presence and influence of transmission nfrastructure beyond that of the existing substation and the Genlee Power Station into an area of currently undeveloped armland with mature boundary and individual field trees.

ubstation extension footprint is c.3-4 times larger than that of the proposed Planning Application Option, and will require a substantial extent of cut and fill and loss of existing mature trees to the north of the penstock.

he reduced footprint of this option offers greater opportunity for he implementation of landscape mitigation planting to assimilate he substation into the immediate and wider landscape, and screen he substation in longer distance views.

iven the increased distance from the closest residential properties of c.200-250m, it is likely that this option would not result in ignificant effects on residential visual amenity during either onstruction or operation.

The removal of the Glenlee-Glenluce (BG Route) terminal tower within the existing Glenlee substation will remove this infrastructure from existing views from the rear of the properties of fummel, Rannoch and Carville, However, whilst all unnecessary ransmission infrastructure, such as switchgear, would be removed rom the existing substation compound, the current transformer, hough not operational, would remain in situ for potential future perational requirements. The site would therefore remain inclosed by steel palisade security fence.

Criteria	Option 1	Option 2 – Alternative substation extension location	Option 3 – Replacement of entire substation (proposed and existing) with an air insulated substation (AIS)
	Mature deciduous field trees will be lost to the south-east of the penstock to facilitate the substation extension.	Given the increased distance from the closest residential properties, it is likely that this option would not result in significant effects on residential visual amenity during either construction or operation	Given the increased distance from the closest residential properties, it is likely that this option would not result in significant effects on residential visual amenity during either construction or operation
The rear Ran of m poto ame exte unii intr imp imn and exis Thi: affe	The removal of trees/hedgerow vegetation to the rear of the properties of Carville, Tummel and Rannoch which currently effectively screen views of much of the existing substation, will lead to potential significant effects on residential visual amenity during construction, and potentially extending into the operational phase as unimpeded views of the existing substation are introduced. However, opportunities may exist to implement mitigation measures to screen immediate views from these properties (fences and replacement hedgerow planting) of both the existing and proposed substation infrastructure. This would be agreed on an individual basis with affected residents.	The removal of the Glenlee-Glenluce (BG Route) terminal tower within the existing Glenlee substation will remove this infrastructure from existing views from the rear of the properties of Tummel, Rannoch and Carville. Connections between the existing substation and the alternative substation extension site would be via trident wood pole OHL connections, crossing the penstock before terminating on new structures to the south-west of the existing Glenlee substation. These are unlikely to appear as prominently in principal views from the rear of residential properties south-west and south of the existing substation, in contrast to the proposed terminal tower proposed in Option 1.	The removal of the Glenlee-Glenluce (BG Route) terminal tower within the existing Glenlee substation will remove this infrastructure from existing views from the rear of the properties of Tummel, Rannoch and Carville. However, whilst all unnecessary transmission infrastructure, such as switchgear, would be removed from the existing substation compound, the current transformer, though not operational, would remain in situ for potential future operational requirements. The site would therefore remain enclosed by steel palisade security fence.
	Routeing Implications:	Routeing Implications:	
	The proposed alignments of the Kendoon- Glenlee and Earlstoun-Glenlee connections from the north-east, and the proposed Glenlee- Tongland and realigned Glenlee-Glenluce (BG Route) connections to the south-west have been identified as the most suitable overhead line connections to the existing Glenlee substation and proposed substation extension site. This contains the presence of transmission infrastructure within an area already occupied by existing infrastructure, thus avoiding the potential for extending landscape and visual effects over a wider area.	The alignment of the proposed Glenlee-Tongland and realignment of the existing Glenlee-Glenluce (BG Route) connections would likely have to c or pass over the higher ground formed by the north-eastern shoulder of Glenlee Hill to the west, south-west of the penstock, before deviating to tower 098-099). This is likely to result in skylining of the towers which would be visible over a greater area, including views from St John's Town of In relation to the Kendoon-Glenlee connections approaching this alternative site from the north-east, the necessary change in alignment will likel south-west of Waterside where the existing proposed alignment utilises the existing wayleave as far as is practical. This alignment is also likely to L7 Spec) into the existing proposed alignment of Glenlee connection once south-west of the woodland. The Earlstoun-Glenlee connection would remain as proposed, and connect to the existing Glenlee substation site from its terminal position via ur	
	The terminal tower for the realigned Glenlee- Glenluce (BG Route) connection will be visible in views from the rear of the residential properties of Orrin and Garry, and to a lesser extent from the rear of the properties of Maree, Navar and Tarbert, resulting in potential significant effects on views from the rear of these properties.		
Hydrology	The vast majority of the site lies above the 1 in 200-year, 1 in 500-year, 1 in 1000-year and 1 in 200-year plus climate change peak water levels for the larger watercourses downgradient (e.g. Water of Ken, Coom Burn, and the Tailrace) and it is at low risk of flooding from these watercourses, and from Dickson's Strand and the burn located to the north-west of the site, south of Glenlee Mains. However, this option will require the diversion of the unnamed watercourse and extension/re-alignment of the existing culvert which runs under the existing Glenlee Substation. The watercourse was culverted through the site of the existing Glenlee substation. The watercourse was constructed. Modelling work has established that the existing culvert is undersized to convey the 1 in 200-year flow. Due to space restrictions within the site and local topography (which is relatively steep to the south of the existing substation and between the substation and the tailrace), modelling work has shown that it is not possible to develop a culvert that can convey the 1 in 200-year flow. Such, it is proposed that flows in excess of the capacity of the network will be conveyed along the proposed substation road network within the site, and intercepted by a 'road verge drain' with a view to minimising the risk of flooding within the site and downstream of the culvert.	Option 2 is located adjacent to the unnamed watercourse which flows in an easterly direction along the southern boundary of the site, before passing under the penstock. This option would require to be cut into the ground next to the watercourse, so the channel would have to be engineered to ensure flows can't enter the site; this would require a licence under the CAR regulations. In addition, infrastructure within the site may have to be raised a suitable freeboard (factor of safety) above flood levels of the watercourse. A detailed flood risk assessment has not been undertaken for this option; however, it appears to be located outside of the 1000 year floodplain of the larger watercourses downgradient (e.g. Water of Ken, Coom Burn, and the Tailrace). This option would not require realignment and culverting of the unnamed watercourse required for Option 1. However, it is possible that this option may still be at risk of flooding from this watercourse and appropriate mitigation measures would be required (e.g. engineering the channel upgradient of the site) and providing a suitable flow-path if the culvert/channel under the penstock became blocked.	Option 3 is located adjacent to the unnamed watercourse which flows in an easterly direction along the southern boundary of the site, before passing under the penstock. This option would require to be cut into the ground next to the watercourse, so the channel would have to be engineered to ensure flows can't enter the site; this would require a licence under the CAR regulations. In addition, infrastructure within the site may have to be raised a suitable freeboard above flood levels of the watercourse. A detailed flood risk assessment has not been undertaken however this option appears to be located outside of the 1000 year floodplain of the larger watercourses downgradient (e.g. Water of Ken, Coom Burn, and the Tailrace). This option would not require realignment and culverting of the unnamed watercourse required for Option 1. However, it is possible that this option may still be at risk of flooding from this watercourse and appropriate mitigation measures would be required (e.g. engineering the channel upgradient of the site) and providing a suitable flow-path if the culvert/channel under the penstock became blocked.

#### Option 4 – Replacement of entire substation (proposed and existing) with a gas insulated substation (GIS)

cross the penstock to meet the existing and preferred alignments wards the existing alignment of Glenlee-Glenluce (BG Route at c. of Dalry and locations on the SUW.

ly result in an increased loss of woodland at Hag Wood to the o require the introduction of two additional angle towers (Type D60

nderground cable.

Option 4 is located approximately 60m north of the unnamed vatercourse which flows in an easterly direction, before passing under the penstock.

This option would require to be cut into the ground, however given the distance from the watercourse, engineering of the watercourse is not likely to be required. However, flood risk from the watercourse would need to be assessed and flood flow paths within the site provided if taken forward. In addition, infrastructure within the site may have to be raised a suitable freeboard above flood levels of the watercourse.

A detailed flood risk assessment has not been undertaken however this option appears to be located outside of the 1000 year floodplain of the larger watercourses downgradient (e.g. Water of Ken, Coom Burn, and the Tailrace).

This option would not require realignment and culverting of the innamed watercourse required for the preferred option. However, it is possible that this option may still be at risk of flooding from this vatercourse and appropriate mitigation measures may be required and providing a suitable flow-path if the culvert/channel under the benstock became blocked.

Criteria	Option 1	Option 2 – Alternative substation extension location	Option 3 – Replacement of entire substation (proposed and existing) with an air insulated substation (AIS)	Op ex
	A maintenance regime will be put in place to maintain the culvert including the inlet and the proposed channel to prevent blockages, thereby minimising the potential for future flood risk.			
Peat	Detailed peat probing has not been undertaken in the peat.	his location. However, a review of the drift geology mapping and the SH	IN carbon and peatland map 2016 indicates that no peat is present in the	ese a
	<ul> <li>Note 3 All vehicles, from both north and south of site will need to use A762 and U2 hence 36 vehicles listed here.</li> <li>Note 5 THIS CALCULATION IS FOR EARTHWORKS ACTIVITIES ONLY – NO ALLOWANCE MADE FOR DELIVERIES, SITE STAFF and VISITORS.</li> </ul>	<ul> <li>Both and the second of the second o</li></ul>	<ul> <li>Note 3 Philo Ph</li></ul>	Com mwc Of P P P P P P P P P P P P P P P P P P
FICICIEILE	<ul> <li>All options are technically feasible and will ach</li> <li>Options 2, 3 and 4 are not economic or efficient</li> <li>Option 2 is not efficient or coordinated, requir</li> <li>Options 3 and 4 are not efficient in that they w being constructed, it is not considered feasible</li> </ul>	nieve the same operational goal of connecting the overhead lines being nt when evaluated against SPEN's statutory and licence obligations as ea ing construction of a new substation extension less than 200m from the yould involve the demolition of an existing substation site with an expect e to utilise existing plant and equipment on the new substation site.	proposed as part of the KTR Project. Ich of these options is at least double the cost in comparison with Option e existing site and increasing risks to customers fed from Glenlee during cted remaining asset life of 20-30 years. Due to operational issues requiri	n 1. ; con fing t
	<ul> <li>Options 2, 3 and 4 extend the presence and inf</li> </ul>	nuence of transmission electrical infrastructure beyond that of the exis	ang substation and the Geniee Power Station into an area of currently u	inde

#### Option 4 – Replacement of entire substation (proposed and existing) with a gas insulated substation (GIS)

se areas and the habitats present do not suggest the presence of

Construction of this option will result in an increase of peak of HGV movements on the following sections of road during the main earth works phase due to an area increase of 1.5 times compared with Option 1<sup>\*</sup> (although this is notably less than for Options 2 and 3):

• A713 north of A762: 18 daily HGV movements over a period of 8.5 months;

A713 south of A762: 18 daily HGV movements over a period of 8.5 months;

A762 between A713 and U2s: 36 daily HGV over a period of 8.5 months:

• U2s: 36 daily HGV movements over a period of 8.5 months.

U2s due to the location on the other side of the penstock vehicle traffic will be passing the hydro station and impacting adjacent properties. Increased disturbance.

Demolition of old substation site will result in an increase of peak of HGV movements on the following sections of road during the demolition of buildings, plant and concrete foundations:

• A713 north of A762: 18 daily HGV movements; • A713 south of A762: 18 daily HGV movements; A762 between A713 and U2s: 36 daily HGV movements; U2s: 36 daily HGV movements.

The requirement to remove the demolished materials would further increase disturbance on the U2s.

Notes and clarifications:

Note 1 The 8.5-month period covers both construction and demolition works.

Note 2 HGV movement accounts for entry and return.

Note 3 Vehicles to remove material, depending on quarry locations - assume 18 from north (towards Ayr) and 18 from south (towards Castle Douglas) of the site.

Note 4 This option is 1.5 times the area of Option 1 but is not necessarily 1.5 times number of vehicle movements. This is because, whereas Option 1, is almost entirely cut operation to remove material; Option 4 may be feasible to achieve some cut / fill balance in alternative location and so reduce vehicle movements on the road to less than 1.5 times but still significantly higher than Option 1. Figures provided above are an estimate on that basis.

Note 5 Durations increased to 8.5 months to allow for construction and demolition as it is not considered feasible to increase vehicle frequency any further from Option 1.

**Note 6** THIS CALCULATION IS FOR EARTHWORKS AND DEMOLITION ACTIVITIES ONLY – NO ALLOWANCE MADE FOR DELIVERIES, SITE STAFF and VISITORS.

ecision has been made on the following basis:

n 1.

construction of the extension.

ng the existing substation to be retained while the new substation is

ndeveloped farmland with mature trees on the boundary.

Criteria	Option 1	Option 2 – Alternative substation extension location	Option 3 – Replacement of entire substation (proposed and existing) with an air insulated substation (AIS)	0 e
	<ul> <li>Options 2, 3 and 4 will likely result in re-alignm west of the penstock. The likely result is that t when compared with Option 1.</li> </ul>	nent of the existing BG Route overhead line and proposed Glenlee to To hese towers would be visible over a more extensive area, including view	ngland routes with the towers having to pass over the higher ground form ws from St John's Town of Dalry and locations on the Southern Upland Way	е /,
	• Due to their elevated nature and topography,	options 2, 3 and 4 will result in extensive earthworks to construct the s	ubstation platform, leading to a further increase in vehicle movements du	ri
	• Options 2, 3 and 4 vary in development footput movements during the construction period.	int size, being between 1.5 and 2.5 times larger than Option 1 and will t	herefore require a greater amount of materials to construct the substation	1
	• Options 2, 3 and 4 (the new sites separate from	n the existing substation) will create a greater visual impact to the surro	ounding area in comparison to Option 1.	

#### Dption 4 – Replacement of entire substation (proposed and existing) with a gas insulated substation (GIS)

ed by the north-eastern shoulder of Glenlee Hill to the west, south-, and leading to potentially greater landscape and visual effects

ing the construction period.

platform and compound, leading to a further increase in vehicle

## Figures







