

Chapter 3

Site Selection and Development Design

3 Site Selection and Development Design

Introduction

The Site and Surrounding Area

- 3.1 The existing Glenlee substation adjoins the Glenlee hydro power station on the Water of Ken, approximately 1.5km south-west of **St John's Town of Dalry**. The site of the substation extension which forms part of the proposed development is bounded to the north by the existing Glenlee substation, hydro power station and local road (the U2S), to the east by residential properties and a local road (the U3S), to the south by undeveloped green field land, and to the west by the penstock of the Glenlee hydro power station and undeveloped green field land. In the wider area, there is an overflow car park located directly across from the existing substation and the rest of the surrounding land is currently mainly agricultural, and is used for grazing livestock.
- 3.2 As detailed in **Chapter 1: Introduction**, the proposed development, excluding the temporary works, covers approximately 0.35ha, and extends primarily to the south-west of SPEN's current land ownership boundary, as illustrated by **Figure 1.1**. In addition, the planning application boundary extends to encompass the areas around the substation extension itself to accommodate temporary works including drainage features, the construction compound, soils and materials storage areas and a vehicle holding area, as well as access from the A762.

Consideration of Alternatives

- 3.3 As detailed in **Chapter 2: Approach to the EIA**, public consultation is a key component of the EIA process and SPEN has undertaken extensive consultation with local communities on the proposals for the proposed development both as part of the wider KTR Project, and in isolation. The consultation that was undertaken has been fundamental to the selection of the final location and design of the proposed development. Full details of the consultation undertaken are detailed in the PAC Report which accompanies the planning application and are also summarised in **Chapter 2** of this EIA Report.
- 3.4 Throughout the development of the final design for the substation extension forming part of the proposed development, a number of alternative options were considered, including several which were raised through the consultation process. Four alternative options were considered in detail as summarised below and were subject to a detailed appraisal in October 2018 as illustrated on **Figure 3.1**.

Option 1: Extension of the Existing Substation Site

- 3.5 This option, (which has been taken forward to EIA and for which an application for planning permission is being submitted), involves extending the existing substation directly adjacent to the south-west. The development footprint includes gantries connecting to the first terminal tower on the proposed realignment of the existing BG overhead line route as part of the wider KTR Project. The development footprint for the substation extension itself is approximately 0.69ha (including the access and changes to ground levels). The existing control building would also require a minor extension.

Option 2: Retain the Existing Substation and Relocate the Proposed Extension to the Opposite side of Glenlee Hydro Power Station

- 3.6 This option involves locating the proposed substation extension behind the existing Glenlee hydro power station as an entirely new substation site. The development footprint for the substation extension is approximately 1.83ha (including the access and changes to ground levels).

Option 3: Move Entire Substation (Proposed and Existing) to the Opposite side of Glenlee Hydro Power Station as an Air Insulated Substation (AIS)

- 3.7 This option would involve moving the whole substation (i.e. existing Glenlee substation plus new extension) as an AIS (with most equipment outdoors, as for the existing substation). This option would

allow the existing substation to be demolished and the site restored. The development footprint for the substation extension is approximately 1.78ha (including the access and changes to ground levels).

Option 4: Move Entire Substation (Proposed and Existing) to the Opposite Side of Glenlee Hydro Power Station as a Gas Insulated Substation (GIS)

- 3.8 This option would involve moving the whole substation as a GIS (with the GIS switchgear contained inside a building). This option would allow the existing substation to be demolished and restored. The development footprint for the substation extension is approximately 1.1ha (including the access and changes to ground levels).

Appraisal of Options

- 3.9 The findings of the appraisal of the four options were published by SPEN in October 2018¹ and are summarised below. The appraisal considered the following criteria:

Economic

- Overall construction cost taking into account expected civil engineering, plant, equipment and labour costs.

Technical

- Size of development footprint;
- Feasibility of construction; and
- Risk to existing customer supply during construction and commissioning of the development.

Environmental

- Landscape and visual amenity;
- Ecology;
- Ornithology;
- Cultural heritage;
- Noise;
- Landscape and visual amenity;
- Hydrology and peat; and
- Access, traffic and transport.

Appraisal Findings

Option 1: Extension of the Existing Substation Site

Economic Considerations

- 3.10 Of the four options considered, Option 1 is considerably cheaper to develop than the other options, all of which have all been calculated as at least twice as expensive (based on 2018 estimates of plant and civil engineering costs). In terms of economics, Option 1 is the most economic and efficient option.

Technical Considerations

- 3.11 Of the four options considered, Option 1 has the smallest footprint. By extending the existing site, outages to existing customers can be effectively managed, and existing plant and equipment can be reused.

¹ Glenlee Substation Appraisal of Alternative Substation Sites (October 2018). Available to download at https://www.spenergynetworks.co.uk/userfiles/file/Glenlee_Appraisal_Report.pdf.

Environmental Considerations

- 3.12 The environmental effects of Option 1 are considered in detail within this EIA Report, however in summary:
- Habitats are common and widespread and potential effects on protected species are considered unlikely. No bird species of note were identified during surveys of the site. Potential effects on ecology are considered in **Chapter 8: Ecology**. Potential effects on ornithology have been scoped out of detailed assessment as set out in **Chapter 2**. This option will require a diversion to an existing watercourse and electrofishing surveys confirmed that no fish or crayfish are present.
 - Test pitting/trial trenching will require to be undertaken to confirm the presence of any features of cultural heritage importance as past surveys have identified the presence of metal working debris which suggests the possible presence of a metal working site in the area. The visual impact of the extension on the setting of nearby cultural heritage assets is considered to be minimal. Potential effects on cultural heritage are considered in **Chapter 9: Cultural Heritage**.
 - 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 2m 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 noise sensitive properties would also be within the set threshold. Potential effects on noise and details of the mitigation proposed are set out in **Chapter 10: Construction Noise**.
 - Through extending the existing substation, the transmission infrastructure will be contained to one side of the penstock and not substantially increase its influence over a wider area. Whilst substantial cut and fill will be required, there are opportunities for screening of the substation and landscape planting has been considered to reduce visibility from nearby properties in particular. The proposed alignments of the overhead lines connecting into the existing and proposed substation extension site will contain 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. Potential effects on landscape and visual amenity are considered in **Chapter 6: Landscape and Visual Amenity**.
 - This option is at low risk of flooding but will require diversion of the unnamed watercourse and extension/realignment of the existing culvert which runs under the existing Glenlee substation and which was constructed at the same time and is undersized to convey the 1 in 2-year flow. This is discussed further in **Chapter 7: Hydrology and Water Resources**. A review of the drift geology mapping and the SNH carbon and peatland map 2016 indicates that no peat is present and the habitats present do not suggest the presence of peat.
 - Peak HGV movements associated with Option 1 have been calculated to last a maximum of three months on the A713 north of A762, A713 south of A762, A762 between A713 and U2S, and the U2S, a considerably shorter time period than the other options considered. Potential effects relating to access, traffic and transport are considered in **Chapter 11: Access, Traffic and Transport**.

Option 2: Retain the Existing Substation and Relocate the Proposed Extension to the Opposite side of Glenlee Hydro Power Station

Economic Considerations

- 3.13 As noted above, Option 2 is over twice as expensive as Option 1 (based on 2018 estimates of plant and civils costs). There is a considerably larger footprint associated with Option 2 compared with Option 1, and additional equipment would also be required to take this option forward.

Technical Considerations

- 3.14 Whilst technically feasible, Option 2 has a considerably larger footprint and carries more risk of outages to existing customers than Option 1. Equipment and plant at the existing substation could be reused.

Environmental Considerations

- 3.15 In summary, the appraisal found the following:

- Habitats are common and widespread and potential effects on protected species are considered unlikely. No bird species of note were identified during surveys of the site. This option does not require a diversion to the existing watercourse.
- As with Option 1, if this option were taken forward, test pitting/trial trenching would be required in relation to the possible metal working site referred to above. It is likely that the visual impact of this option on nearby cultural heritage assets would be slightly increased compared to Option 1 due to the change to the alignment of the overhead lines that would connect in to the substation.
- Option 2 would be likely to result in slightly lower noise levels than Option 1 during construction and mitigation would therefore be unlikely to be required. Noise levels from vehicles would be within the set threshold.
- This option would extend the presence and influence of electrical infrastructure beyond that of the existing substation and the Glenlee hydro power station into an area of currently undeveloped farmland with mature boundary and individual field trees. It would 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. There is less opportunity for implementation of landscape mitigation planting to assimilate the substation into the immediate and wider landscape. The alignment of the overhead line routes required for this option would extend visibility of transmission infrastructure over a wider area than Option 1.
- 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. A review of the drift geology mapping and the SNH carbon and peatland map 2016 indicates that no peat is present and the habitats present do not suggest the presence of peat.
- Peak HGV movements associated with Option 2 have been calculated to last a maximum of five months on the A713 north of A762, A713 south of A762, A762 between A713 and U2S, and the U2S. There would be increased disturbance on the U2S compared with Option 1 due to the location on the other side of the penstock.

Option 3: Move Entire Substation (Proposed and Existing) to the Opposite side of Glenlee Hydro Power Station as an AIS

Economic Considerations

- 3.16 As noted above, Option 3 is over twice as expensive as Option 1 (based on 2018 estimates of plant and civils costs). There is a considerably larger footprint associated with Option 3 compared with Option 1, and additional equipment would also be required to take this option forward. The costs for this option also include for demolition of the existing substation which would be required.

Technical Considerations

- 3.17 Whilst technically feasible, Option 3 has a considerably larger footprint and carries more risk of outages to existing customers than Option 1. Equipment and plant at the existing substation, which still has a 20-30 year operational lifetime, would have to be demolished.

Environmental Considerations

- 3.18 In summary, the appraisal found the following:

- Habitats are common and widespread and potential effects on protected species are considered unlikely. No bird species of note were identified during surveys of the site. This option does not require a diversion to the existing watercourse.
- There are no previously recorded heritage assets in the area around Option 3. It is likely that the visual impact of this option on nearby cultural heritage assets would be slightly increased compared to Option 1 due to the change to the alignment of the overhead lines that would connect in to the substation.
- Option 3 would be likely to result in slightly lower noise levels than Option 1 during construction due to the increased distance from the nearby residential properties and mitigation would therefore be unlikely to be required. Noise levels from vehicles would be within the set threshold. The existing

transformer would not be required and would 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.

- This option extends the presence and influence of electrical infrastructure beyond that of the existing substation and the Glenlee hydro power station into an area of currently undeveloped farmland with mature boundary and individual field trees. It 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. There is less opportunity for implementation of landscape mitigation planting to assimilate the substation into the immediate and wider landscape. The alignment of the overhead line routes required for this option would extend visibility of transmission infrastructure over a wider area than Option 1.
- 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. A review of the drift geology mapping and the SNH carbon and peatland map 2016 indicates that no peat is present and the habitats present do not suggest the presence of peat.
- Peak HGV movements associated with Option 3 have been calculated to last a maximum of nine and a half months on the A713 north of A762, A713 south of A762, A762 between A713 and U2S, and the U2S. The requirement to remove the demolished materials would further increase disturbance on the U2S.

Option 4: Move Entire Substation (Proposed and Existing) to the Opposite Side of Glenlee Hydro Power Station as a GIS

Economic Considerations

- 3.19 As noted above, Option 4 is over twice as expensive as Option 1 (based on 2018 estimates of plant and civils costs). There is a considerably larger footprint associated with Option 4 compared with Option 1, and additional equipment would also be required to take this option forward. The costs for this option also include for demolition of the existing substation.

Technical Considerations

- 3.20 Whilst technically feasible, Option 4 has a larger footprint and carries more risk of outages to existing customers than Option 1. Equipment and plant at the existing substation, which still has a 20-30 year operational lifetime, would have to be demolished.

Environmental Considerations

- 3.21 In summary, the appraisal found the following:
- Habitats are common and widespread and potential effects on protected species are considered unlikely. No bird species of note were identified during surveys of the site. This option does not require a diversion to the existing watercourse.
 - There are no previously recorded heritage assets in the area around Option 4. It is likely that the visual impact of this option on nearby cultural heritage assets would be slightly increased compared to Option 1 due to the change to the alignment of the overhead lines that would connect in to the substation.
 - Option 4 would be likely to result in slightly lower noise levels than Option 1 during construction due to the increased distance from the nearby residential properties and mitigation would therefore be unlikely to be required. Noise levels from vehicles would be within the set threshold. The existing transformer would not be required and would be taken out of service. A new GIS 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.
 - This option extends the presence and influence of electrical infrastructure beyond that of the existing substation and the Glenlee hydro power station into an area of currently undeveloped farmland with mature boundary and individual field trees. It 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 reduced footprint of this option offers greater opportunity for the implementation of landscape mitigation planting to assimilate the substation into the immediate and wider landscape, and screen the substation in longer distance views. The alignment of the overhead line routes required for this option would extend visibility of transmission infrastructure over a wider area than Option 1.

- 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. A review of the drift geology mapping and the SNH carbon and peatland map 2016 indicates that no peat is present and the habitats present do not suggest the presence of peat.
- Peak HGV movements associated with Option 4 have been calculated to last a maximum of eight and a half months on the A713 north of A762, A713 south of A762, A762 between A713 and U2S, and the U2S. The requirement to remove the demolished materials would further increase disturbance on the U2S.

Preferred Option

- 3.22 Following consideration of the technical, economic and environmental factors relating to each of the four options, as indicated above, SPEN concluded that the option to be taken forward to EIA and the planning application is Option 1. This decision has been made on the following basis:

- All options are technically feasible and would 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 of 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 supplied currently by Glenlee hydro power station 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 hydro 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 as indicated by the increased duration of the peak traffic movements compared with Option 1.
- 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. This will lead to a further increase in vehicle movements during the construction period as indicated by the increased duration of the peak traffic movements compared with Option 1.
- 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.

- 3.23 It is acknowledged that Option 1 will give rise to greater impacts on residents during the construction period as a result of construction noise 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.
- 3.24 In relation to Option 1, the extension site itself 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.
- 3.25 Having considered the reasonable alternatives to the substation extension forming part of the proposed development in the context of its statutory and licence duties, SPEN considers that Option 1 (an extension to the existing substation site) is the most technically feasible, economic and efficient option. It is the option which causes, on balance, least disturbance to the environment and people. However, SPEN also recognises that Option 1 will cause disturbance to residents and landowners, and is committed to working with them to explore further opportunities to mitigate the potential effects during both the construction and operational phases of the proposed development.

The Substation Extension Design

- 3.26 The Horlock Rules provide guidelines for the siting and design of new substations, or substation extensions, to avoid or reduce the environmental effects of such developments². The substation extension location was primarily determined by its proximity to the existing substation and the requirement to connect existing/replacement OHLs as part of the KTR Project as detailed above, and the form of the substation extension forming part of the proposed development is governed by its function. Notwithstanding this, the following substation design principles have been adopted for the proposed development:
- the use of high quality construction materials appropriate to the locality;
 - landscape planting using appropriate species to provide screening (further details are provided in **Chapter 4: Development Description, Construction, and Operation and Maintenance**).

² The Horlock Rules were devised in 2003 and updated in 2006 by National Grid Company (NGC) plc.