VOLUME 2 – CHAPTER 4: CONSIDERATION OF ALTERNATIVES

Figures (Volume 3 of this EIA Report)

There are no figures associated with this Chapter.

Appendices (Volume 4 of this EIA Report)

There are no appendices associated with this Chapter.

4. THE SITE SELECTION PROCESS AND ALTERNATIVES

4.1 Introduction

4.1.1 This Chapter describes the substation site selection approach and process, how reasonable alternatives were identified and assessed which are relevant to the proposed project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects.

4.2 Consideration of Alternative Substation Sites

Site Selection Process

4.2.1 SSEN Transmission operating under licence held by Scottish Hydro Electric Transmission plc has a statutory duty under section 9 of the Electricity Act to develop and maintain an efficient, co-ordinated and economical electrical transmission system in its licence area. Where there is a requirement to extend, upgrade or reinforce its transmission network, SSEN Transmission's aim is to provide an environmentally aware, technically feasible and economically viable solution which would cause the least disturbance to the environment and to people who use it.

4.2.2 The approach to site selection has been informed by SSEN Transmission's Substation Site Selection Procedures for Voltages at or above 132 kV guidance document[1] (hereafter referred to as SSEN Transmission's Substation Guidance). The guidance advocates a three-stage process, Stage 0 Pre-Site Selection, Stage 1 Initial Site Screening and Stage 2, Detailed Site Selection, as illustrated in **Figure 1**.

4.2.3 The starting point in all substation site selection processes is to establish the need for the project and the preferred strategic option to deliver it. The definition of need and subsequent strategic options assessment is frequently iterative and will often be subject to change even after commencement of the initial site screening (and occasionally the detailed site selection) stages.

4.2.4 At Stage 1, the objective is to identify and compare technically feasible, economically viable and environmentally acceptable candidate site options within a defined area of search, typically a radius of 5 km from a connection point. The aim is to identify a short-list of 2-4 least-constrained, potential (or candidate) sites, based on a combination of technical and environmental factors, using data gathered mostly from desk-based sources, for further assessment at Stage 2, with Site options compared relative to each other, and not in absolute terms. GIS, site walkover, initial feedback from landowners (grantors) and other stakeholders may also be used. The analysis often involves comparing the relative importance of different factors and this importance might change with different site combinations.

4.2.5 Stage 2 seeks to identify, from the candidate site options considered at Stage 1, the least constrained site, which avoids where possible, physical, environmental and amenity constraints, is likely to be acceptable to stakeholders and which is economically viable taking account of the engineering and connection requirements. The assessment builds on the data and information used at Stage 1, and would usually include site walkover, and granter feedback. In some cases, intrusive investigations and specific engagement with consultees may be undertaken to inform the assessment.

4.2.6 Ultimately, sites need to be developable in technical terms and consentable from an environmental, planning, and economic development policy perspective, taking into account national and local environmental and planning regulations and legislation. Securing ownership of land is a fundamental part of the process.

Project Need and Strategic Options

4.2.7 In July 2022, National Grid, the Electricity System Operator (ESO)[1], published the Pathway to 2030 Holistic Network Design (HND)[2], setting out the blueprint for the onshore and offshore electricity transmission network infrastructure

[1] The ESO was replaced by the National Energy System Operator in 2024.
[2] National Grid, Electricity System Operator (ESO) (2022) Pathway to 2030 Holistic Network Design (HND). Available [online]: https://www.neso.energy/document/262676/download

required to enable the forecasted growth in renewable electricity across Great Britain, including the UK and Scottish Government's 2030 offshore wind targets of 50 GW and 11 GW respectively.

4.2.8 The ESO's Pathway to 2030 HND confirmed the requirement to increase the power transfer capacity of the onshore corridor from Kintore to Tealing. To meet its duty and provide for a significant and strategic increase in the capacity of the onshore electricity transmission infrastructure for the north of Scotland, SSEN Transmission is developing the new 400 kV overhead line (OHL) between Kintore and Tealing, as part the East Coast 400 kV Phase 2 Upgrade. This also requires new 400 kV substations, including Emmock substation, to be constructed to provide grid connection to enable future renewable energy connections and export routes to areas of demand.

Site Requirements

4.2.9 To meet the project need, it was determined that an Air Insulated 400kV double busbar configuration would be required. To deliver this requirement, the site selection process sought to identify the following:

- A site, on predominantly flat ground (with a gradient of no more than 15%), large enough to accommodate a site substation platform of notionally 550m x 550m, with additional land to accommodate sustainable drainage, landscaping structures and features, land for biodiversity net gain (BNG), internal access, and land for construction activities (site compounds, materials storage, equipment laydown);
- A site capable of being accessed by technically feasible, economically viable and environmentally acceptable future connection options;
- A site which is within 5 km of the existing Fiddes grid connection point;
- A site which avoids areas of "high amenity value" interpreted as being sites designated for their natural or cultural heritage value at international and national levels;
- A site which avoids interaction with existing and future planned infrastructure (other transmission projects, roads, railways, communications, wind farms and pipelines) (in the case of underground pipelines, allowing for a buffer of no less than 100 m from any existing assets);
- A site at least 1 km from the coast, to reduce the risk of saline corrosion;
- A site which avoids hazards, neighbouring hazardous land uses, and potential soil contamination or pollution.
- A site which is not vulnerable to flood risk (climate adjusted 1:200, as defined by Scottish Environment Protection Agency) or subsidence;
- A site which avoids residential and other properties, and which is capable of being substantially screened from view by properties in the vicinity and locations which are used by the local community; and
- A site which is capable of being accessed from local roads allowing for local road improvements.

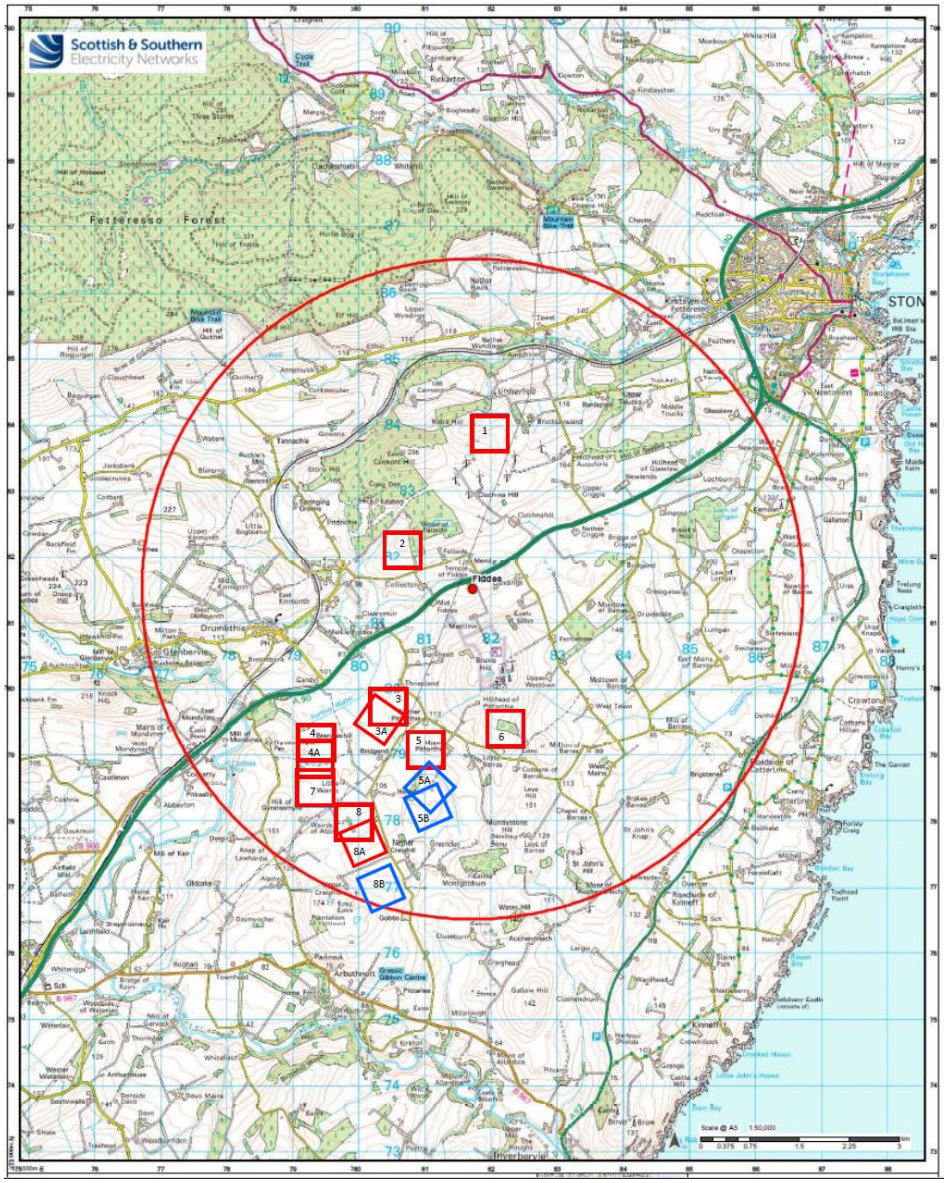
4.3 Initial Site Alternatives

4.3.1 A Site Selection Area of Search was defined as the area within a 5 km radius of the Fiddes grid connection point, excluding a 1 km strip along the coast defined by the A92.

4.3.2 High-Level Suitability Multi-Criteria Analysis (MCA) and Geographic Information System (GIS) tools were used to identify candidate site options within the Area of Search, applying the principles in SSEN Transmission's Substation Guidance as summarised above and with the Site Requirements.

4.3.3 Eight sites were identified as suitable for the initial screening stage. Following site visits by the SSEN Transmission project team, iterations of four original site options (denoted as "A" or "B" on **Figure 4.1** below) were subsequently included as part of the assessment. These 14 candidate site options were assessed in a second workshop where 11 of the 14 sites were discounted due to the proximity of underground infrastructure, such as oil and gas pipelines, Site elevation, visibility, and topography.

Figure 4.1: Site Options



Site Options Proceeding to Stage 2: Detailed Site Selection

4.3.4 Three sites were considered to warrant further and more detailed appraisal in the Detailed Site Selection:

- Site 5A - located adjacent to Upper Pitforthie Farm on relatively flat terrain, comprising open arable farmland. The site includes a single wind turbine which would have to be removed to accommodate the new substation;
- Site 5B - located north of Nether Craighill on relatively flat terrain, comprising open arable farmland. The site includes a single wind turbine which would have to be removed to accommodate the new substation; and
- Site 8B - located north of Gobbs Farm on terrain rising to the west towards Upper Craighill and the site of a Scheduled Monument at Hillhead. The land-use broadly comprised open arable farmland crossed by some minor drains.

4.4 Summary of Detailed Site Selection

4.4.1 The following section provides a comparative assessment of the environmental, engineering and cost considerations for each substation site option (Sites 5A, 5B and 8B).

Environmental

4.4.2 While candidate Site 5A is located further from properties and settlements compared to Sites 5B and 8B, a large area of the Site 5A is vulnerable to flood risk, based on SEPA Future Flood Map data indicating areas of a 200-year plus

climate change floodplain associated with the Bridgend Burn. Moreover, development of Site 5A would require the diversion of the Bridgend Burn, which was considered a risk to contestability.

4.4.3 Site 8B is in close proximity to designated cultural heritage assets, in particular the Scheduled Monument (SM) at Hillhead Long Cairn, where potentially significant impacts on the setting of the SM are anticipated. A residential property (Upper Craighill) lies approximately 150 m west of Site 8B and is likely to experience open close proximity views.

4.4.4 Site 5B and Site 5A were preferred over Site 8B due to their location at a greater distance from cultural heritage assets. Site 5B had a lower risk of flooding in comparison to Site 5A but had a higher risk of flooding than Site 8B. There is one residential property located within the area of the candidate site, (Rowanwell House), and one property immediately adjacent (Hareden), both of which are likely to experience open views of the Site. There are properties approximately 240 m south, with open views into the Site, 260 m west and 400 m south, all with generally open views, with few intervening features. In addition, a property called Bloomfield, understood to be the childhood home of the author Lewis Grassic Gibbon lies 320 m west of the Site. On balance, it was considered that the implications of flood risk associated with Site 5A were of greater materiality in the comparative appraisal to the amenity and visibility constraints of Site 5B.

4.4.5 Site 8B was considered to be least preferred due to its proximity to designated cultural heritage assets. The amenity of an adjacent property would also likely be impacted. While Site 5B may impact a larger number of residential properties, the land use planning (and environmental impact assessment) process gives greater weight to impacts on designated sites than on private residential properties and residential amenity.

Engineering

4.4.6 From an engineering perspective, Site 5B is considered to offer potential connections which would result in the least disruption to the existing OHL network in terms of diversion and outages. Furthermore, the largely flat nature of Site 5B requires less extensive earthworks to form a substation platform, Site 5B sits within a shallow valley and was well connected to the public road network. This site also had a minimal slope from south to north, and notwithstanding its lower elevation compared to surrounding land, has a lower flood risk compared to the other candidate sites and an absence of shallow groundwater.

Cost

4.4.7 Site 8B is located on a comparatively more steeply sloping site and is therefore considered the likely highest cost due to the extent of civil works required to form a substation platform. Furthermore, the water table is higher at Site 8B, increasing the complexity of foundation design to avoid impacts on the infrastructure from the water table and the complexity of the civils operation in managing water arising during excavation. While the requirement for landscaping works (bunding) to mitigate visual impact is greater at Sites 5A and 5B, the extent and therefore the cost of works required are considered unlikely to alter the overall civils works cost comparison.

4.4.8 In terms of land assembly, while the purchase costs of each site are not considered likely to be differentiators, Sites 5A and 5B would be likely to incur greater costs than Site 8B, as a result of the possible need to acquire residential properties which are considered likely to experience significant impact on amenity.

4.4.9 Considering the costs associated with diverting existing infrastructure to accommodate the new 400 kV OHL and substation connections, given that all three candidate sites are located to the east of the existing 275 kV and 132 kV OHLs and given the likelihood that the new 400 kV OHL would be located to the west, the existing infrastructure would require diversions, lowering or undergrounding to accommodate the crossing over of the 400 kV OHL. While the costs of such are considered broadly similar for Sites 5A and 5B, due to the topography around Site 8B, these works would be more complex and therefore more costly.

4.4.10 All three candidate sites have broadly similar public road improvement requirements and unlikely to differentiate between options. Likewise, operational costs are anticipated to be broadly similar.

4.4.11 Overall, taking into account the civils works and infrastructure diversion works costs, Site 8B was considered to represent highest comparative cost. There was little to distinguish between Sites 5A and 5B, except that costs of

associated with Site 5A were considered likely to be marginally higher, as a result of the works required to divert the Bridgend Burn.

Conclusion

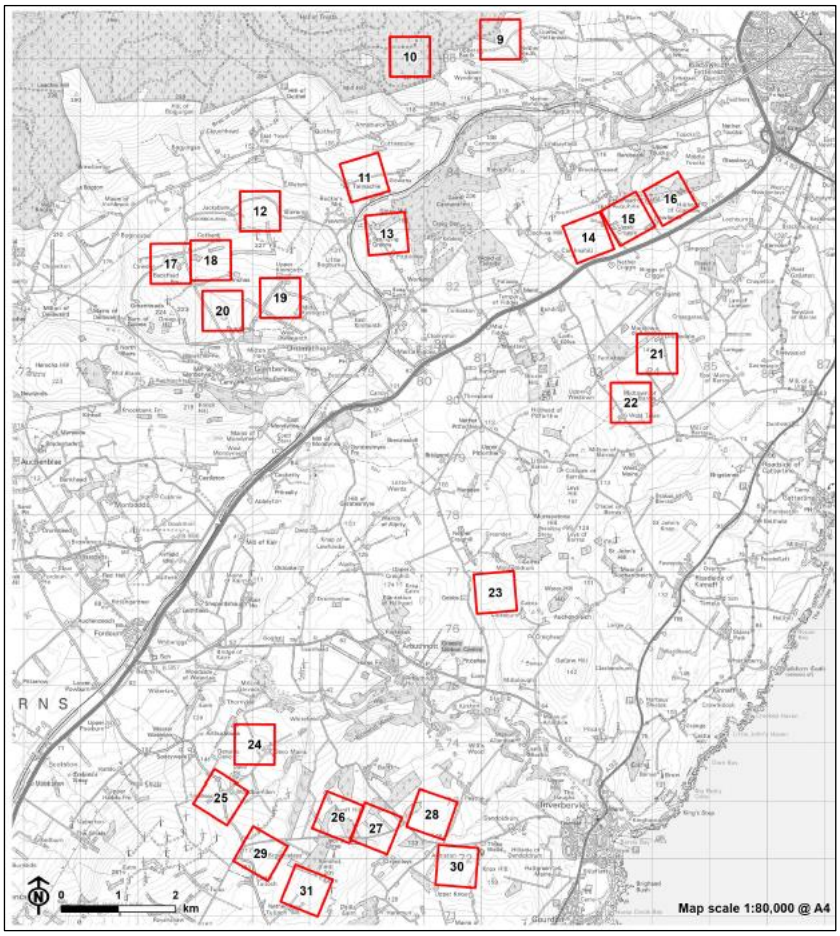
4.4.12 Despite cost considerations for Site 8B being the highest, Site 5A was least preferred based on flood risk and the required diversion of the Bridgend Burn. In comparing Sites 5B and 8B, 8B was least preferred for cost and its potential to impact cultural heritage assets. On balance, Site 5B was determined to be the least constrained of the three candidate sites.

4.5 Extended Site Selection Process

4.5.1 Following a review of technical requirements, an assessment of the association of the general area with the author Lewis Grassic Gibbon and considering initial consultation feedback, the site selection process was extended.

4.5.2 Applying similar principles to the initial site screening, the Area of Search was widened to a radius of 10 km from the existing Fiddes Substation, excluding the area east of the A92. A further 23 candidate sites (in addition to the initial sites described and assessed above) were identified based on the extent of unobstructed or usable land, absence of nearby properties and settlements, topography, and absence of existing infrastructure. See **Figure 4.2** below.

Figure 4.2: Extended Site Options



4.5.3 Based on an initial assessment appraisal of site size, proximity to properties, presence of existing infrastructure and connection opportunities to existing and new OHL infrastructure, 14 candidate sites were discounted. The remaining 10 were further appraised for extent of developable land, topography and engineering constraints (earthworks), new OHL connection options, interaction with existing infrastructure if present, extent of visibility, the presence of designated natural and cultural heritage features, land cover/use and habitat type, habitat suitability for protected species, flood risk, watercourses and drainage, as well as access. In the course of the assessment, Sites 26, 27, 28

and 30 were combined given their proximity to each other and their similarity in terms of environmental and technical characteristics.

4.5.4 The remaining five sites were then appraised with a further two sites discounted due to landscape and visual constraints as well as proximity to properties, flooding and the presence of prime agricultural land within the Site boundary. The remaining three sites were then appraised at a greater level of detail, with a further site being discounted largely due to the presence of watercourses within the Site boundary, the wide viewshed due to the prominence within the skyline, the close proximity to properties and a large area of prime agricultural land (Class 3.1) being located within the Site boundary. As a result of the assessment, two candidate sites were taken forward for further detailed assessment; the land area covered by Sites 26 and 27 referred to collectively as Banff Hill, and land at Fetteresso Forest.

4.5.5 The assessment of land at Banff Hill and Fetteresso Forest which included testing different platform orientations and electrical configurations, was informed by the following:

- an environmental and technical assessment of different connection options for 400 kV OHL, as part of route selection process;
- an assessment of land ownerships and initial enquiries to landowners regarding willingness to grant;
- the possible presence of peat at the land at Fetteresso, warranting a peat probe investigation; and
- a comparative assessment of the two locations, Banff Hill and Fetteresso against the least constrained options from the initial site assessment, Sites 5B and 8B.

Environmental Considerations

4.5.6 From a natural heritage perspective, the least constrained site was considered to be Site 8B. Hurlie was potentially constrained by UKBAP species due to the potential for the site to support red squirrel (*Sciurus vulgaris*) and pine marten (*Martes martes*). The presence of badger (*Meles meles*) within the landscape may also constrain Hurlie, Banff Hill and Site 5B. The presence of Schedule 1 birds within the landscape around Hurlie, including goshawk, red kite and osprey, constrained the substation site area. In terms of hydrology, surface waters significantly constrained the sites at Hurlie and Banff Hill, mainly due to the presence of the Burn of Day and Banff Burn at the respective sites. Site 5B was constrained by the Bridgend Burn but to a lesser extent than the other two sites.

4.5.7 Hurlie was the least constrained with respect to cultural heritage considerations. Site 5B and to a greater extent Site 8B were constrained by Scheduled Monuments within the landscape. Site 5B was largely constrained by the potential to compromise the setting of Montgoldrum Cairns & Hut Circle (SM 4754) and Montgoldrum, Cairn (SM 4820) which were located within 1 km of the Site, as well as Hillhead Long Cairn (SM 4820), located approximately 1.4 km from the Site. Site 8B was considered to likely compromise the setting of Hillhead Long Cairn (SM 4534) and Montgoldrum, Cairns & Hut Circle (SM 4754) which were located approximately 290 m to the west and 880 m to the east of the Site respectively. The Arbuthnott Garden Design Landscape (GDL) was located within 5 km of Banff Hill and constrained the site due to the potential to compromise the setting of the GDL. The presence of Listed Buildings also significantly constrained the site at Banff Hill as there was the potential to compromise the setting of two Category A Listed Buildings: Allardyce Castle (LB 2878) and Benholm Castle and Tower (LB 2807). A key constraint raised during consultation was the proximity and the association of the land that Sites 5B, 8B, and to a lesser extent Banff Hill, were situated within in relation to the work of Lewis Grassic Gibbon (a prominent Scottish author) including the Lewis Grassic Gibbon Centre, and the potential impacts the sites could have on compromising the legacy.

4.5.8 Landscape and visual considerations constrained all site options. Banff Hill was constrained by the Arbuthnott House GDL, located approximately 750 m to the north of the site with the potential to compromise its special qualities, specifically its scenic value. All four proposed substation sites were constrained by the potential to compromise landscape character. Visual amenity was a significant constraint to Sites 5B, 8B and Banff Hill, largely in relation to the proximity to residential properties, and also constrained the site at Hurlie due to the location of the site on higher ground, but to a lesser extent.

4.5.9 Each site was constrained to a degree by land use considerations. Agriculture constrained Banff Hill, Site 5B and Site 8B as the sites were partially located on prime agricultural land (class 1, 2.1 and 3.1). Site 5B was the most

constrained as 75% of the land within the Site was classed as prime agricultural land. Banff Hill and Site 8B were less constrained by prime agricultural land as 15% and 30% of the land within the Site consisted of prime agricultural land. Hurlie was not situated upon any prime agricultural land. Forestry was a constraint to Hurlie as the site was located within Fetteresso Forest where the commercial returns of the forestry operations may be compromised as a result of the Proposed Development.

4.6 Further Consideration of Alternatives During the EIA Process

4.6.1 The work that was undertaken during the site selection process enabled a rigorous consideration of reasonable alternatives with respect to site selection and the consideration of different design solutions available for the project. The Proposed Development has been subject to several design changes as a result of feedback from the consultation events, and to eliminate, avoid, or mitigate environmental and technical constraints. Alternatives were explored with respect to the specification and location of equipment, infrastructure, drainage arrangements, landscape design proposals and biodiversity. See **Figure 3.2 General Arrangement** for the evolution of the Site design.

Technology Solutions (AIS vs GIS)

4.6.2 SSEN Transmission is developing both air insulated switchgear (AIS) and gas insulated switchgear (GIS) infrastructure currently, with technology choice dependent on site requirements, which are in turn influenced by strategic network requirements. The base case in technology selection and therefore site selection, is AIS. While such technology requires a larger site footprint than GIS, which in turn has implications for landscape and local visual amenity, habitats and wildlife and surface drainage, these considerations are balanced against the need to maintain network operability and service continuity, feasibility and speed of maintenance / repair of the infrastructure and cost (as a business regulated by Ofgem). The relative advantages and disadvantages of AIS versus GIS typically see GIS employed in more exposed locations, such as those closer to the coast, where the need to utilise buildings to protect the main switchgear is more prevalent.

4.6.3 The starting point in selecting a site for a new substation is to locate a plot large enough to accommodate AIS technology, while meeting the other site requirements listed at section 4.2.9 above. The expectation being that a site large enough to accommodate an AIS solution would also be sufficient to accommodate a GIS solution. Should this process be unable to identify a site capable of meeting the requirements of technical suitability, consentability and economic feasibility for an AIS solution, GIS technology would be considered more explicitly. This would include cases where the only suitable sites are in exposed locations e.g. coastal, requiring greater use of buildings. It is also worth noting that in order to make the connections to the various circuits coming into a 400kV substation, sites using GIS technology for the main switchgear will utilise sections of AIS busbar, which reduces the overall size differential between the two technologies. This is because the AIS busbars do not rely on containing gas to operate effectively, making them less vulnerable to environmental corrosion in the Scottish climate than gas insulated busbar, which has benefits for network reliability.

4.6.4 Once candidate sites capable of meeting the technical requirements for the selected technology have been identified, the site selection process focusses on the selection of the least constrained site of the candidates identified, taking into account environmental, technical and cost considerations, as described in sections 4.3-4.5 above.

Platform Location Alternatives

4.6.5 The substation design was refined by reducing the platform length slightly from 760m to 685m, narrowing the western edge, and rounding the northeast corner. The cut at the southwestern end has been substantially reduced, which has allowed the eastern toe of the platform to be significantly reduced in extent. As a result, the Applicant has been able to reduce the overall footprint of the works area from approx. 45 ha to just under 24.5 ha.

Visual Impact

4.6.6 The site has an increased slope from north-east to south-west which requires cut and fill of the hillside in order to construct the substation platform. Reduction of the platform size along with the cut at the southwestern end allows for a longer slope outwith the northeastern toe of the platform. This reduces the amount of surplus earthworks and allows for increased planting by an equivalent extent. The western, north and eastern edges of the platform would be

wrapped in woodland block planting which will strengthen visual screening to what is already a well screened platform due to the topography of the site.

Landscape and Drainage Design

4.6.7 The reduction of the platform toe has allowed the platform slopes to be extended to the northeast forming a more naturalistic shape and allowing for the SuDS basin 2 to be moved, providing a clearway for cable entries on the drainage line including a septic tank discharge and soakaway.

Access

4.6.8 Based on public feedback, the Applicant has examined options for principal construction access which avoid the A957 Slug Road and the residential parts of west Stonehaven. Some construction traffic may still access the Site from the south of Slug Road, via west Stonehaven, but these would be limited to smaller deliveries and construction personnel. The likely principal route, which Contractors would be required to follow, from both north and south, would be the A90 AWPR, exiting at the Peterculter Junction, and joining the B9077, then joining the Slug Road at Crathes, and arriving at the principal access to the site from the north. The same route would be proposed to be used for two-way construction vehicle movements. In addition, some smaller deliveries and personnel may access the Site (independently or by Contractor arranged transport) from the unclassified Auchenblae Road to the south of the Site, and not from the unclassified Auchenblae Road, to the south of the site, as previously planned.

Technical Considerations

4.6.9 From a technical perspective, the sites at Banff Hill and Hurlie were less constrained than Sites 5B and 8B in terms of the possible disruption to the existing transmission network and in terms of the amenity of local settlements and properties. In terms of deviations to the preferred route of the Kintore to Tealing 400kV OHL, which was predicated by Sites 5B and 8B, there was little to distinguish between Banff Hill and Hurlie, with each being broadly similar distances from the preferred route, although a connection to Banff Hill would need to skirt the Hill of Garvock and a connection to Hurlie would require the navigation of more steeply sloping land from the south on the approach to Hurlie. From a civil engineering point of view, Hurlie was most constrained, considered likely to require the largest extent of earthworks to create a substation platform, followed by Banff Hill. Both sites were assessed to require greater earthworks compared to Sites 5B and 8B. Further, Hurlie was considered most constrained of the four options in terms of the implications of constructing a substation in an operating commercial forest.

Cost

4.6.10 In comparative terms, the sites at Hurlie and Banff Hill were considered likely to involve larger costs than Sites 5B and 8B, largely as a result of the extent of earthworks required to create the substation platform. On balance, Hurlie was considered likely to represent the highest cost option because of the more complex topography, land use and ground conditions compared to Banff Hill.

Conclusion

4.6.11 Notwithstanding the technical and cost constraints, Hurlie was selected as the preferred option by virtue of least environmental constraints. While environmental constraints exist at Hurlie, these were considered to be capable of management and mitigation with the result that Hurlie was considered to represent the most consentable of the four options.