Meridian Solar Farm

EN010169

Volume 8

Post-Submission Application Documents

8.40 Review of the Scheme Against the Electricity Transmission Design Principles

APFP Regulation 5(2)(q)

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

October 2026

Contents

1. Introduction **3**

1.1. Overview 3
1.2. Summary of the Electricity Transmission Design Principles 3

2. Alignment with the Electricity Transmission Design Principles **5**

1. Introduction

1.1. Overview

1.1.1. This document forms part of an application by Meridian Solar Farm Limited to the Secretary of State under the Planning Act 2008 (the 'Act') for a Development Consent Order (the DCO Application) for the Meridian Solar Farm (the Scheme).

1.1.2. The purpose of this document is to provide a review of the Scheme against the Electricity Transmission Design Principles (ETDP) published by the National Electricity System Operator (NESO) in June 2026.

1.1.3. This document should be read alongside information that is contained within the other application documents and plans.

1.2. Summary of the Electricity Transmission Design Principles

1.2.1. The ETDP, published by NESO in June 2026, provide overarching guidance for the development and design of electricity transmission infrastructure. They are intended to provide greater clarity and consistency across transmission design, support effect engagement and consultation, and help to streamline transmission planning and consenting processes. The ETDP sit alongside, rather than replace, existing planning policy, guidance and regulatory requirements.

1.2.2. The National Policy Statement for Electricity Networks Infrastructure EN-5, paragraph 2.9.20 requires that developers have regard to the ETDP in addition to the Holford and Horlock Rules, while paragraph 2.11.2 requiring the Secretary of State to have regard to the ETDP when determining applications. At the time the Applicant was preparing its DCO application, the ETDP had not yet been published by NESO. The Applicant has set out how it has had regard to the relevant design policy and guidance at the time within the **Design Approach Document** [APP-268].

1.2.3. As the ETDP was published during the Examination, the Applicant considers it appropriate for the ExA to have regard to the ETDP in its assessment of the Scheme in accordance with paragraphs 2.9.20 and 2.11.2 of EN-5. The Applicant has therefore produced this note to assist the ExA with confirming the Scheme's alignment with these design principles in response to ExQ1 Q2.0.13.

1.2.4. This note does not provide an assessment against the principles in Sections 3 and 4 of the ETDP as these relate to broader strategic planning principles, rather than principles appropriate to apply as part of project development. Therefore, this

note focusses on the application of the principles set out in Section 5: Project Development Principles. This assessment should be read in the context of the assessments provided in the **Design Approach Document** [APP-268] and the **Planning Statement** [APP-260].

1.2.5. The following assessment in Table 1-2 confirms that the Scheme accords with the ETDP.

2. Alignment with the Electricity Transmission Design Principles

2.1.1. This section summarises the relevant design principles within Section 5: Project Development of the ETDP, and how the Scheme accords. It does not consider Principles O2 and O3 as those relate to offshore development, which are not relevant to the Scheme.

Table 2-1 Relevant Design Principles

Design Principle	Alignment
Overhead Lines	
T3: The starting presumption for support structures for double circuit overhead transmission lines is that they be of a steel lattice design. Rationale Where double-circuit overhead transmission lines are selected (see Principle T2 on the overhead line starting presumption for further details), steel lattice towers offer several benefits over other forms of support structures (e.g. monopole constructions such as T-pylons). They have lower levels of embodied carbon (less concrete and steel, whilst still retaining excellent structural integrity), they are easier to construct and maintain (in general they do not require permanent access roads and they can be serviced using smaller site vehicles), and they are more cost-effective. In addition, the lengths of steel angle-section used in lattice towers can be more easily transported to, and assembled in, hard-to-access areas than the prefabricated sections of monopole designs, causing less disruption to the environment and local ecology. Alongside other benefits, the relatively open silhouette of lattice towers make them easier to see through, allowing them to be backdropped by local landscape features (especially in wooded or moorland areas).	The Applicant proposes the use of steel lattice towers for the Grid Connection Route. Section 3.5 of **ES Chapter 3: Alternatives and Design Evolution** [APP-054] describes the various pylon types available for a 400kV connection. Steel lattice pylons have been adopted as the starting point for the design as they offer the greatest degree of flexibility in terms of span length, height, and alignment. This flexibility allows the route to be optimised to respond to site-specific constraints. Other pylon types were also considered; however, within the context of the Site, these alternatives would be likely to give rise to broadly similar environmental effects and would not deliver any substantive environmental benefits over the steel lattice option. Folded Steel Pylons, T-Pylons and Monopoles also typically have shorter span ranges than lattice steel pylons. As such, they were not selected.

Design Principle	Alignment
Alternative tower designs, such as monopole and lower height steel lattice towers can reduce landscape disruption and lessen visual impacts in certain highly situation-dependent settings. However, these designs are often more difficult to construct and maintain. Additionally, their increased costs must be weighed against their effectiveness. Overhead lines form the backbone of the electricity supply to the national economy, so must continue to operate reliably through the very harshest British weather conditions. For this reason, whatever factors contribute to the selection of a transmission support structure design for a given project, be they technical, visual or both, only thoroughly tested, durable designs should be considered. <u>Design Considerations</u> • Where adverse effects of steel lattice towers on key receptors cannot be mitigated by careful routeing, consider whether alternative tower designs could be visually advantageous and economically justified. • Differences in national planning policy frameworks between England, Wales, and Scotland. • Locations of any transitions between different tower designs along a continuous route, considering technical requirements and visual impact. • Altitude, wind-speeds, ice loading and ground conditions for the tower and foundation design. • Wood poles as a proven alternative to single circuit steel lattice transmission designs (132 kV in Scotland only), where future double-circuit capacity is not envisaged.	For the single circuit 132kV overhead line within the Overhead Inter-Array Connection, two wood pole designs options were considered. These are also described within Section 3.5 of **ES Chapter 3: Alternatives and Design Evolution** [APP-054]. Single wooden poles generally require a smaller physical footprint at each pole location. As a result, they can slightly reduce land take and ground disturbance compared to an H frame pole. Their more slender form can also result in reduced visual prominence when viewed in isolation, particularly within rural landscapes. However, the difference in effects between the options is minimal, due to the limited land-take of either option. The feasibility of using single trident wood poles to accommodate power via High Temperature, Low Sag (HTLS) conductors is unknown, as there are no established UK precedents for 132kV HTLS circuits using single wood poles. As such, due to engineering feasibility, the Scheme therefore adopts double wood poles (H frame) for the Overhead Inter-Array Connection, which have greater mechanical strength and load capacity.

Design Principle	Alignment
• Opportunities to install structures capable of supporting higher voltages operation and operating at a lower standard voltage in the interim.	
T4: Route options for overhead lines should avoid or seek to minimise the impact on areas of amenity value which are afforded protection through national planning policies, acknowledging the hierarchy of protection designations Rationale The most direct route between two substations is usually the most economic choice for new overhead lines, as it has the potential to minimise the length of infrastructure required and therefore reduces materials and construction costs. However, in developing route options for new overhead lines, designers may encounter areas of particular sensitivity. These may include settlement areas, designated landscapes, protected habitats, and Heritage Coasts. National Policy Statements (NPS) for England and Wales, and National Planning Framework 4 (NPF4) for Scotland, assign varying levels of protection of amenity to these areas that should be considered and addressed by all proposals for new developments. Design should endeavour to avoid or minimise, the impacts on the amenity value of sensitive areas. It is important to balance the benefits of following the hierarchy of designated protections in national planning policies against the technical feasibility and the costs of routeing an overhead line to avoid areas of amenity value. Design considerations • The type and extent of protection afforded to designated areas or buildings under relevant national planning policies.	The Grid Connection Route and the Overhead Inter-Array Connection avoid National Parks, National Landscapes, and national or international ecological designations. No such designations lie within, or immediately adjacent to, the route corridor.

Design Principle	Alignment
• Differences in policy frameworks and protection levels between England, Wales, and Scotland. • In England, certain designated landscapes have statutory purposes set out in legislation, and public bodies are required to seek to further those purposes when exercising their functions. • Trade-offs associated with lengthening routes to avoid protected areas, including the additional number, location and impact of the larger angle towers which are required. to change the direction of the new overhead line.	
T5: Route options for overhead lines should seek to balance the impacts on communities and the environment with technical and cost considerations Rationale Overhead line routes traverse areas of varying landform, topography, ecology, land use and population. The routeing of an overhead line should follow a landscape-led approach, seeking to balance competing factors to minimise the line's overall impact on communities and the environment while delivering the technical need. This could involve, for example, balancing the benefits of avoiding prominent skylines or ridgelines and using natural screening (e.g. trees or hills) to break up views of the infrastructure and reduce perceived height of supports, against the potential drawback of routeing in lower-lying areas which may bring infrastructure closer to settlements and properties. Re-routing part of the line is likely to affect adjacent sections of the line. Design decisions should, therefore, demonstrate how often competing considerations are balanced along the length of the overhead line route.	The landscape across both route corridors, being the Grid Connection Route and Overhead Inter-Array Connection, is predominantly flat fenland, without hills, ridges, or substantial tree backdrops capable of providing effective "back-clothing" of OHL towers. As such, the opportunity to follow landform features is limited by the baseline landscape character. The absence of elevated landforms means neither the Grid Connection Route nor the overhead Inter-Array Connection cross ridges or skyline features. The Applicant sought to balance the impacts on communities by avoiding routes that would pass within close proximity to settlements. **ES Chapter 3: Alternatives and Design Evolution** [APP-054] describes the alternatives the Applicant considered and how

Design Principle	Alignment
Design considerations • Proximity to settlements and land use categories, including residential, industrial, and mixed-use areas. • Topography and landform features that influence visibility and provide opportunities for screening, while ensuring appropriate buffers. • Cumulative visual impacts from existing electricity infrastructure and other developments. • Opportunities to maintain visual consistency in tower design, height, and alignment. • Ecology, including wildlife areas such as woodlands, wetlands or bird migratory routes. • Deliverability and accessibility of the route for construction and ongoing maintenance. • Cost of the different route options.	proximity to communities influenced the design development. The open and sparsely planted fenland landscape requires careful management of visual clutter, including cumulative visual impacts from existing electricity infrastructure. For both overhead elements of the Scheme: • Existing DNO OHLs and underground assets were mapped and assessed during routing. • Crossings of existing electricity infrastructure were designed to be perpendicular or near-perpendicular wherever practicable, minimising prolonged visual convergence. • Unnecessary parallel running with smaller distribution lines is avoided. • A key consideration is coordination with National Grid Electricity Transmission's proposed G2W project. In this context, a broadly parallel arrangement between the two 400 kV routes represents a more coherent design response than dispersing major transmission infrastructure across separate corridors. Containing large-scale transmission infrastructure within a defined

Design Principle	Alignment
	corridor reduces landscape fragmentation and limits the spread of perceived wirescape. • The overhead Inter-Array Connection, by contrast, performs a localised functional role between parcels and has been designed to remain visually subordinate in scale and extent, avoiding unnecessary interaction with wider transmission infrastructure.
T6: Where a continuous overhead line route that avoids designated landscapes cannot be identified, consider forms of mitigation for environmental, community and technical impacts Rationale Where a proposed new continuous overhead line route passes through one or more designated or protected areas and re-routeing is not feasible, a review of the likely adverse effects should be undertaken as part of any required environmental assessments to determine whether there is an emerging case for considering other forms of mitigation. Planning for mitigation should be undertaken at the earliest opportunity, so costs are factored into decision making. Mitigation options come with their own set of challenges and must be thoroughly justified in balancing economic viability, technical feasibility and the extent of the predicted effects on a receptor or grouping of receptors. Where, following conversations with affected stakeholder(s), (1) the effects on a sensitive receptor or group of receptors, are assessed by the relevant professional	The overhead line routes do not cross any designated landscapes.

Design Principle	Alignment
as being over and above the thresholds of significance defined in relevant environmental assessment legislation and guidance, or (2) where the technical feasibility brings into question the continuity of an overhead line, and (3) where these effects cannot be otherwise mitigated, undergrounding sections of the line may be the only viable alternative. The assessment of potential underground solutions must carefully balance the advantages and disadvantages of undergrounding, considering environmental impact, costs and associated technical issues within the context of relevant obligations. <u>Design considerations</u> • Where factors are identified that call into question the continuity of an overhead line route, carefully assess the advantages and disadvantages of undergrounding, including environmental and community considerations, while ensuring that costs remain proportionate to the benefits delivered and mindful of the technical and operational challenges associated with undergrounding. • As a guiding example, undergrounding a section of a line should be carefully considered where it crosses a National Park, Area of Outstanding Natural Beauty or a National Scenic Area, provided no suitable overhead line route can be identified. • Ground conditions preventing certain cable ratings, complex crossings with other infrastructure, other designations and limited access areas. • Availability of space for cable sealing end compounds and their impacts on the visual amenity. • Alternative tower designs (see Principle T3).	

Design Principle	Alignment
• Compensatory planting where woodland is removed.	
T7: Consider overhead line transmission routes and designs that minimise susceptibility to high-impact physical and climate-related events <u>Rationale</u> The increasing frequency of extreme weather events due to climate change threatens the resilience of Great Britain's transmission networks. Whilst overhead lines are designed to be exposed to sustained periods of wind and rain, temperature fluctuations and ice loading, this infrastructure remains susceptible to more severe external influences, including very high temperatures, wildfires, intense flooding and airborne debris. These climate-related events, such as flooding and wildfires, can damage conductors and tower structures, leading to temporary disruptions (e.g. electrical flashovers) or more permanent failures that pose safety risks and can undermine the system's operational flexibility, heightening the risk to security of supply. In addition to environmental risks, transmission routes may also be exposed to malicious threats, such as sabotage or vandalism, which could result in significant outages and safety hazards. Given that transmission infrastructure is rarely relocated once built and is designed for operational lifespans of up to 80 years, it is essential to embed resilience against both physical and security risks in routeing and design decisions from the outset. <u>Design considerations</u> • Risk zones, including areas prone to natural hazards such as flooding, land slip, high winds, icing, and wildfires, can restrict access for maintenance or repair. Risks can be mitigated with strategies such as designing for flood	The overarching project vision for the Scheme, as described in the **Design Approach Document** [APP-268], seeks to embed resilience and sustainability into the design. Section 7.8 of **ES Chapter 7: Climate Change** [APP-058] and **ES Appendix 7-2: Climate Change Risk Register** [APP-179] contain a climate change risk assessment, considering the impact of changing climate conditions on the Scheme. It also identifies the mitigation relevant to each climate change risk. Mitigation relevant to climate change risks have been embedded into the proposals of the Scheme, and impacts from the Scheme as a whole, including the embedded mitigation, have been assessed throughout the ES chapters. Section 7.7 of **ES Chapter 7: Climate Change** [APP-058] presents a summary of built in climate resilience measures, including those with regards to flood risk. Safety critical elements of the Scheme (such as On-Site Substation and BESS Compounds, Solar Stations and Cable Sealing End Compounds) have been designed to be resilient to flooding. Further information is also presented within **ES Appendix 11-3: Flood Risk Assessment** [AS-020].

Design Principle	Alignment
resilient infrastructure, crossing at a risk zone's narrowest point, as directly as possible, spanning the lowest flood levels by choosing tower locations above normal flood levels or using strengthened tower designs. • Nature based solutions for mitigating certain impacts such as peatland restoration to stabilise soils and store carbon. • Malicious threats, such as sabotage or vandalism, ensuring that the materials and the way in which they're used maintain or improve current levels of physical security (e.g. enhanced anti-climb measures).	
Underground Cables	
U1: Where underground transmission cables are proposed, impacts on communities, the environment and visual amenity need to be balanced with the costs and inevitable technical constraints of underground cable technology, including ground conditions, land use and access. <u>Rationale</u> Underground transmission cable routeing differs fundamentally from the landscape-led approach used for overhead lines. While overhead line design prioritises minimising visual and landscape impacts, underground cable routeing is primarily engineering-led, since routes are determined largely by technical feasibility, constructability, safety, and cost. High-capacity AC underground circuits require wide construction swathes (typically 35–70 metres) to allow for heat dissipation, with trenches to bury cables around 1.2 metres deep. These physical requirements, combined with the need to avoid challenging ground conditions, flood zones, and sensitive and protected habitats, and the greater motivation for routes to be shorter due to the higher cost	As per the strong starting presumption for overhead lines set out within EN-5, the Applicant has opted for overhead lines. However, the Applicant has elected to use underground cables in two scenarios: • The Inter-Array Connection between the 132 kV substation in Parcel A and the 400 kV substation in Parcel B. This decision was primarily driven by consultation feedback and by consideration of the potential safety and operational impacts that an OHL could have on the Peterborough and Spalding Gliding Club operating at Crowland Airfield. • A section of underground cabling has been added to the Grid Connection Route, crossing the existing 132kV OHL between 4SV15 and 4SV16.

Design Principle	Alignment
of underground cables, often result in routes that diverge significantly from those of an equivalent overhead line. Although, with the exception of their sealing ends, cables are less visually intrusive post-construction, underground cable installation causes substantial ground disturbance and has the potential to increase environmental and landowner impacts significantly during installation, compared to that of an equivalent overhead line. The success of land reinstatement varies by land type, being quicker and least visible in agricultural land and most visible and long-lasting in uplands or semi-natural areas. Unlike overhead lines, which can span certain obstacles such as protected waterways and habitats, underground cables typically avoid them altogether or, where practicable, use specialist methods, such as horizontal directional drilling (HDD) or tunnelling, to install the cables safely under the obstacle. This can significantly increase project costs and in some locations may not be technically feasible. As such, careful route selection, habitat protection and reinstatement, and long-term access planning are essential to minimise both temporary and permanent environmental effects. <u>Design considerations</u> • Cable technical constraints including bending radii, above-ground accommodation of sealing ends, heat dissipation, access for maintenance, and additional AC reactive power compensation equipment, where relevant and DC converter stations. • Environmental disturbances during construction and repair (such as noise, visual, air quality, soil migration, contamination, stability, and drainage).	Oversailing the existing asset is not technically feasible, therefore, the option to underground the proposed alignment was introduced to avoid impacting the existing infrastructure. Two cable sealing end compounds either side of the existing 132kV OHL have been added into the design along with the associated works. The Applicant considers this an appropriate balance between overhead and underground technologies.

Design Principle	Alignment
• Designated and undesignated archaeology including Scheduled Monuments. Opportunities and risks associated with routeing along existing and proposed disturbed corridors such as roads or existing infrastructure to reduce overall impacts, being mindful of physical security risks, physical resilience implications and access requirements during construction and operation. • Longer construction and repair times than overhead lines. Note The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 provisions for construction as well as for operational conditions. Safety and land use requirements in areas directly above the buried cables. • The cost and availability of underground cables for a given application, which may vary on a case-by-case basis. • Susceptibility to high-impact physical and climate related events, including flooding or drought. • Innovative high technology readiness level (TRL) techniques that improve transmission cable installation speeds or reduce impacts.	
Substations	
S4: Where appropriate, locate new substations or converter stations near to the infrastructure to which it will connect <u>Rationale</u> During the project development stage, substation siting choices should be optimised to reduce transmission infrastructure requirements and associated impacts. For new substations or converter stations, consideration should be given	The Applicant is not responsible for the siting or delivery of the Weston Marsh B substation that will connect it to the NETS, and therefore has no influence over the siting of that infrastructure. The Scheme's On-Site 400kV substation is located directly adjacent to the Solar Development Area, with the 132kV substations situated within the Solar

Design Principle	Alignment
to locating them close to the transmission assets to which they will connect, or, at least, close to the preferred transmission route, as this typically reduces the extent of the new transmission connections required, thereby reducing both the associated impacts and the cost. Design considerations • Distance to existing transmission infrastructure requiring connection or diversion. • Number and configuration of circuit entries and exits and the length and routeing complexity of new transmission connections required. • Land availability and ground conditions. • Access requirements for construction and maintenance. • Environmental, community and other planning constraints for the areas under consideration.	Development Area amongst the solar PV panels. The 132kV substations for Land Parcels A and D are situated in areas of the PV area which are closest to Land Parcels B and C to provide a shorter route for the connecting 132kV cable.
S5: Siting of new substations and converter stations should seek to minimise susceptibility to high-impact physical and climate related events Rationale Extreme climate related events, such as floods, land slip, wildfires and heatwaves, present an enduring threat to the resilience of Great Britain's transmission networks. These events are increasing in frequency and intensity due to climate change, which poses new challenges for designers of transmission substations. Substations are also susceptible to malicious threats, such as sabotage and vandalism.	The overarching project vision for the Scheme as described in the **Design Approach Document** [APP-268] seeks to embed resilience and sustainability into the design. Section 7.8 of **ES Chapter 7: Climate Change** [APP-058] and **ES Appendix 7-2: Climate Change Risk Register** [APP-179] contain a climate change risk assessment, considering the impact of changing climate conditions on the Scheme. It also identifies the mitigation relevant to each climate change risk. Mitigation relevant to climate change risks have been embedded into the proposals of

Design Principle	Alignment
Careful engineering consideration of not only the technical requirements but also the environmental factors (including visual amenity) and stakeholder views will allow siting to balance these risks with a view to reducing overall effects and improving infrastructure security. Once constructed and in operation, transmission infrastructure is rarely relocated due to its scale and its integral role in providing security of supply. Moreover, substations are generally designed to operate for 40 years, or longer, so it is important to consider physical and future climate related risks in the positioning and design of new transmission infrastructure. <u>Design considerations</u> • Avoidance of areas prone to natural hazards such as flooding, land slip, subsidence, high winds, icing, and wildfires. • Electrical redundancy and diversity of substation auxiliary supply. • Single points of failure for incoming and outgoing circuits of the Main Interconnected Transmission System (MITS). • Materials and equipment that operate efficiently under foreseeable environmental conditions. • Security enhancing measures, for example, flood prevention through nature-based solutions, water barriers or raising equipment within a substation or converter station; such design details would be subject to engineering judgement regarding its efficacy, and dependent upon any consequential landscape and visual impacts, but note that nature-based design features can help protect the development against climate related	the Scheme, and impacts from the Scheme as a whole, including the embedded mitigation, have been assessed throughout the ES chapters. Section 7.7 of **ES Chapter 7: Climate Change** [APP-058] presents a summary of built in climate resilience measures, including those with regards to flood risk. Safety critical elements of the Scheme (such as On-Site Substation and BESS Compounds, Solar Stations and Cable Sealing End Compounds) have been designed to be resilient to flooding. Further information is also presented within **ES Appendix 11-3: Flood Risk Assessment** [AS-020].

Design Principle	Alignment
events whilst also restoring and managing ecosystems to benefit both people and the environment. • Ease of operational and maintenance access. • Measures to deter non-authorised entry to substations and mitigate the impact of other malicious actions on or relating to the substation.	
S6: Substations may be designed for indoor or outdoor service, and may comprise air insulated or gas insulated switchgear, dependent upon many site-specific factors <u>Rationale</u> A substation may be installed either outdoors or indoors, and it may comprise either air-insulted switchgear (AIS) or gas-insulated switchgear (GIS). Both enclosure choices and both insulation technologies have their advantages; outdoor AIS can often be the economic choice for new substation designs, however, the key benefit of GIS, namely that it normally requires a reduced ground footprint compared to that of AIS, means it can, in some cases, offer a more economic and efficient solution. Some further comparative details follow. *The ETDP contains additional rationale for determining whether a substation should be indoors or outdoors, or whether they should be insulated by air or gas. Due to length, the Applicant has not reproduced those sections in full here.* <u>Design considerations</u> • Substation design is complex and affected by many variables, including (but not limited to):	The Applicant has proposed AIS substations given the location of the Scheme is not spatially constrained, nor are there any conditions at the Site which would make a GIS substation more preferable.

Design Principle	Alignment
• Space available for each substation site option given the availability of unconstrained land areas. • Visual impact from key viewpoints considering the smaller footprint of a GIS block building versus the larger footprint and openness of outdoor AIS. • Expected pollution levels (salt spray, industrial or other airborne pollution). • Cost of the different substation options including lifetime costs. • Severity of anticipated weather conditions such as heavy icing or high winds. • The global warming potential of the composition of gases that comprise the insulating medium. • Ecological and resources effects such as disturbance of peat and mineral-rich soils, whose impacts are sensitive to the volume of construction earthworks.	
S7: Optimise, with respect to its surroundings, the space to be occupied by any new substation or converter station, its line entries, and potential future extensions. <u>Rationale</u> Whilst Substation Principle S3 urges the designer to set aside enough space for current and future substation needs, this complementary Principle focuses upon using that space efficiently, balancing technical requirements with careful regard to the community and the uses of land into which it is placed, to minimise disruption to the lives, businesses and environment that its arrival effects.	The substations proposed would not be subject to future line entries as they are solely for use as part of the Scheme. All relevant environmental and technical constraints have been considered and balanced in the siting of the substations. No ancient woodland, historic hedgerows or designated nature conservation areas will be directly impacted by the proposed substations. All On-Site Substation Compounds are located on agricultural land,

Design Principle	Alignment
Early consultation with stakeholders allows understanding of the local issues, as a first step to optimising the location and layout of the substation and its transmission line entries. Consideration should be given to mitigating any changes of access to roads, buildings, footpaths and fields and to the useability of land parcels that are left surrounding the station. Consideration should also be given to mitigating environmental impacts. In rural locations this could be through tree planting or earthworks, for which additional ground space would most likely be required whilst, in urban environments, suitable perimeter walls or buildings might offer the most appropriate impact mitigation of visual effects. <u>Design considerations</u> • Access and egress for abnormal indivisible loads. • Access and accommodation for Construction. • Access, egress, and control point facilities for emergency services (fire, police and ambulance). • Utility diversions. • Detour lengths and routes for established rights of way. • Drainage considerations, minimising environmental impacts and maintaining established field boundaries. • Environmental factors such as ecology and biodiversity, cultural heritage, archaeology visual and acoustic noise.	and no removal of existing vegetation is required within the compound footprints. The fenland study area contains no prominent ridges, elevated landforms or woodland blocks that could be used to backcloth terminal towers. As such, opportunities for landscape integration through landform are limited. Nonetheless, the proposed planting strategy, set-back distances, and the careful arrangement of structures within compounds all contribute to reducing the prominence of the substations in key views.
S8: Consider the implications of overhead line and underground cable connections in the siting and design of substations or converter stations, and any mitigation or enhancement required.	The line entries for both the 400kV Grid Connection OHL and the 132kV Inter-Array Connection OHL have been designed to ensure clear separation. No low

Design Principle	Alignment
Rationale Where overhead lines converge and enter a substation or converter station, the visual effect of the lines and their terminal towers, or 'wirescape' must be carefully considered. The design of these assets should endeavour to mitigate cumulative wirescape issues by siting line entries and using visual screening in this way helping to ensure that landscape and environmental factors are considered alongside technical requirements. Design considerations • Existing and planned overhead line entries, potential conglomerations of structures and wires, as seen from key viewpoints. • Cumulative visual impacts at key viewpoints due to anticipated substation or converter station extensions or new line entries. • Visual impact mitigation such using landscaping as screening. • Designated landscape impacts and any mitigation or enhancement required. • Planned customer connections to sites via either overhead line or underground cables. • Environmental factors such as ecology and biodiversity, cultural heritage and archaeology.	voltage or other OHLs are located in proximity to the substation entries that would result in a visual convergence or a confusing appearance.
S9: The design of substations, converter stations, access roads and other ancillary developments should consider the local environment in the vicinity of the new infrastructure. Rationale	Environmental constraints and opportunities have been considered from the outset of the design process, including all stages of site selection and refinement for the substations and BESS compounds. Survey results, flood modelling, landscape and visual assessment,

Design Principle	Alignment
A new substation or converter station, with its access road and other ancillary developments can have a considerable impact upon the ecology, hydrology and visual amenity of the locality. However, with careful consideration during the project development stage, most effects can at least be mitigated, if not avoided. Substation and converter station design should ensure that, whilst any new substation achieves its functional purpose, its impacts on its surroundings are studied through required environmental assessments to inform the design so that impacts can be avoided and where not, mitigated as necessary. For visual impact mitigation this could take the form of careful siting and layout of the infrastructure, consideration of the design, colour and form of buildings, or partial visual screening with vegetation or earthworks. For ecological impacts, substation design should avoid negative effects, but where this is not possible, minimise and mitigate such negative effects. <u>Design considerations</u> • Ecological effects on the surrounding area, including potential impacts on habitats and species. • Hydrological conditions, such as flood risk and water flow patterns, which influence both siting and design of infrastructure and access roads. • Visual impact from key viewpoints, with opportunities for mitigation through siting, layout, building form, colour, and screening measures. • The protection or avoidance of groundwater protection zones.	ecological appraisal, and heritage considerations have all directly influenced the evolution of the substation locations and configurations. The proposed application layout represents the outcome of an iterative process seeking to keep adverse effects as low as reasonably practicable while maintaining deliverability and compliance with technical requirements. Given the predominantly flat fenland setting, opportunities to use landform or existing screening to reduce visual intrusion are limited. However, the proposed mitigation planting and landscape strategy has been designed to break views and soften the presence of substation structures. Mitigation planting has been designed to help screen and reduce views of the On-Site Substation Compounds from residential properties in the surrounding area.

Design Principle	Alignment
S10: When designing substations, substation extensions, and converter stations, seek to minimise carbon impact in construction and operations. Rationale As with all major infrastructure projects, the construction of substations and extensions depends on materials such as concrete and steel, which are often manufactured using relatively carbon-intensive processes. Designers should seek to minimise the lifetime carbon impact from these sources whilst also considering other sustainable construction and operational solutions that may arise from time to time. See Principle S6 for further considerations of the use of SF6 and alternative interrupting and insulating gases (IIG) to reduce carbon-equivalent impacts on the environment. Design considerations • Extent of disturbance to natural carbon sequestration (e.g. trees, peat, wetlands, ponds and seagrass) • The degree to which the substation's layout follows land contours, to minimise energy-consuming earthmoving. • Type(s) of concrete used, and associated water consumption. • Potential for natural air and oil flow cooling systems to reduce operational emissions, supported by appropriate equipment and thermal designs, and noting the trade-off with this leading to larger equipment sizing.	The Scheme does not require the use of Sulphur Hexafluoride (SF6) as air-insulated substations are proposed. Section 7.8 of **ES Chapter 7: Climate Change** [APP-058] presents a whole-life carbon assessment, including an assessment of residual emissions against UK carbon budgets and sectoral targets. Greenhouse gas emissions during the construction, operation and decommissioning of the Scheme are considered to be 'offset' by the net positive impact of the Scheme on greenhouse gas emissions and the UK's ability to meet its carbon targets.

Design Principle	Alignment
• Balance between lifetime operational emissions from technical losses and cooling, and the embodied carbon from equipment manufacture.	