OUTER DOWSING OFFSHORE WIND

Outer Dowsing Offshore Wind

Outline Plans

Design Principles Statement

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Acronyms & Definitions

Abbreviations / Acronyms

Acronym	Expanded name
AOD	Above Ordnance Datum
DAD	Design Approach Document
DCO	Development Consent Order
DPS	Design Principles Statement
DRP	Design Review Process
EIA	Environmental Impact Assessment
EPP	Evidence Plan Process
ES	Environmental Statement
ETG	Expert Topic Group
HDD	Horizontal Directional Drilling
HVAC	High Voltage Alternating Current
IDB	Internal Drainage Board
LDP	Local Design Panel
NGSS	National Grid Onshore Substation
NPS	National Policy Statement
NSIP	Nationally Significant Infrastructure Project
ODOW	Outer Dowsing Offshore Wind (The Project)
OnSS	Onshore Substation
PEIR	Preliminary Environmental Information Report
TJB	Transition Joint Bay

Terminology

Term	Definition
400kV cables	High-voltage cables linking the OnSS to the NGSS.
400kV cable corridor	The 400kV cable corridor is the area within which the 400kV cables connecting the onshore substation to the NGSS will be situated.
The Applicant	GT R4 Ltd. The Applicant making the application for a DCO. The Applicant is GT R4 Limited (a joint venture between Corio Generation (and its affiliates), Total Energies and Gulf Energy Development (GULF)), trading as Outer Dowsing Offshore Wind. The Project is being developed by Corio Generation, TotalEnergies and GULF. .
Baseline	The status of the environment at the time of assessment without the development in place.
Connection Area	An indicative search area for the NGSS.
Development Consent Order (DCO)	An order made under the Planning Act 2008 granting development consent for a Nationally Significant Infrastructure Project (NSIP).
Effect	Term used to express the consequence of an impact. The significance of an effect is determined by correlating the magnitude

Term	Definition
	of the impact with the sensitivity of the receptor, in accordance with defined significance criteria.
Environmental Impact Assessment (EIA)	A statutory process by which certain planned projects must be assessed before a formal decision to proceed can be made. It involves the collection and consideration of environmental information, which fulfils the assessment requirements of the EIA Regulations, including the publication of an Environmental Statement (ES).
Environmental Statement (ES)	The suite of documents that detail the processes and results of the EIA.
Haul Road	The track within the onshore ECC which the construction traffic would use to facilitate construction.
Impact	An impact to the receiving environment is defined as any change to its baseline condition, either adverse or beneficial.
Joint bays	An excavation formed with a buried concrete slab at sufficient depth to enable the jointing of high voltage power cables.
Landfall	The location at the land-sea interface where the offshore export cables and fibre optic cables will come ashore.
Link boxes	Underground metal chamber placed within a plastic and/or concrete pit where the metal sheaths between adjacent export cable sections are connected and earthed.
Mitigation	Mitigation measures are commitments made by the Project to reduce and/or eliminate the potential for significant effects to arise as a result of the Project. Mitigation measures can be embedded (part of the project design) or secondarily added to reduce impacts in the case of potentially significant effects.
National Grid Onshore Substation (NGSS)	The National Grid substation and associated enabling works to be developed by the National Grid Electricity Transmission (NGET) into which the Project's 400kV Cables would connect.
National Policy Statement (NPS)	A document setting out national policy against which proposals for Nationally Significant Infrastructure Projects (NSIPs) will be assessed and decided upon
Onshore Export Cable Corridor (ECC)	The Onshore Export Cable Corridor (Onshore ECC) is the area within which, the export cables are routed within to the landfall to the onshore substation will be situated.
Onshore substation (OnSS)	The Project's onshore HVAC substation, containing electrical equipment, control buildings, lightning protection masts, communications masts, access, fencing and other associated equipment, structures or buildings; to enable connection to the National Grid
Outer Dowsing Offshore Wind (ODOW)	The Project.

Term	Definition
Order Limits	The area subject to the application for development consent. The limits shown on the works plans within which the Project may be carried out.
The Planning Inspectorate	The agency responsible for operating the planning process for Nationally Significant Infrastructure Projects (NSIPs).
Preliminary Environmental Information Report (PEIR)	The PEIR was written in the style of a draft Environmental Statement (ES) and provided information to support and inform the statutory consultation process during the pre-application phase.
The Project	Outer Dowsing Offshore Wind, an offshore wind generating station together with associated onshore and offshore infrastructure.
Project Design Envelope	A description of the range of possible elements that make up the Project's design options under consideration, as set out in detail in the project description. This envelope is used to define the Project for Environmental Impact Assessment (EIA) purposes when the exact engineering parameters are not yet known. This is also often referred to as the "Rochdale Envelope" approach.
Receptor	A distinct part of the environment on which effects could occur and can be the subject of specific assessments. Examples of receptors include species (or groups) of animals or plants, people (often categorised further such as 'residential' or those using areas for amenity or recreation), watercourses etc.
Statutory consultee	Organisations that are required to be consulted by the Applicant, the Local Planning Authorities and/or The Planning Inspectorate during the pre-application and/or examination phases, and who also have a statutory responsibility in some form that may be relevant to the Project and the DCO application. This includes those bodies and interests prescribed under Section 42 of the Planning Act 2008.
Transition Joint Bay (TJBs)	The offshore and onshore cable circuits are jointed on the landward side of the sea defences/beach in a Transition Joint Bay (TJB). The TJB is an underground chamber constructed of reinforced concrete which provides a secure and stable environment for the cable.
Trenched technique	Trenching is a construction excavation technique that involves digging a trench in the ground for the installation, maintenance, or inspection of pipelines, conduits, or cables.
Trenchless technique	Trenchless technology is an underground construction method of installing, repairing and renewing underground pipes, ducts and cables using techniques which minimize or eliminate the need for excavation. Trenchless technologies involve methods of new pipe installation with minimum surface and environmental disruptions. These techniques may include Horizontal Directional Drilling (HDD), thrust boring, auger boring, and pipe ramming, which allow ducts to be installed under an obstruction without breaking the open ground and digging a trench.

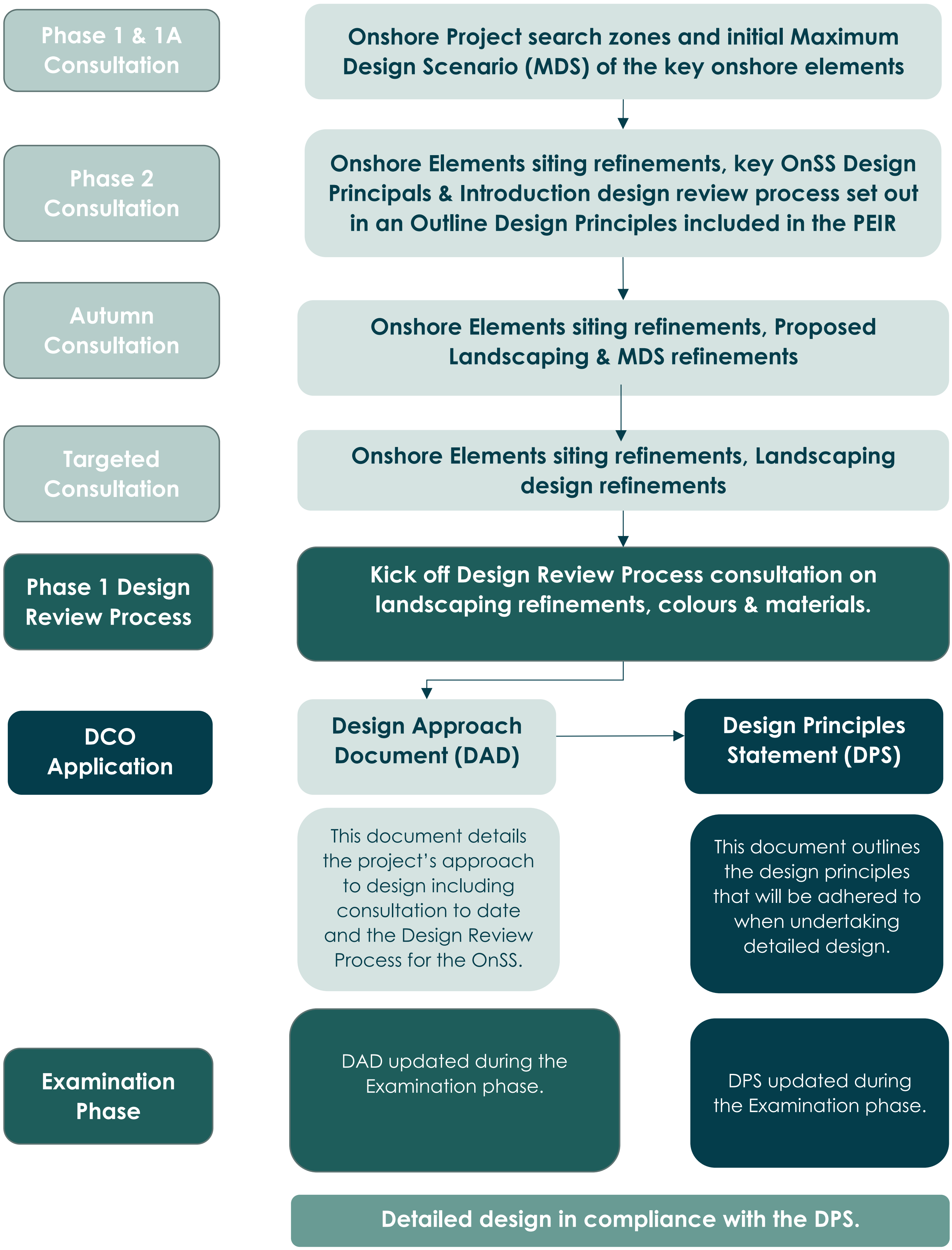
1 Introduction

1.1 Purpose of the Design Principles Statement (DPS)

1. This Design Principles Statement (DPS) sets out the key design principles adopted by the Project for the onshore substation (OnSS), as well as outlining the design elements that will be agreed through the Design Review Process and how these will be implemented throughout the detailed design of the Outer Dowsing Offshore Wind (hereafter referred to as 'the Project') OnSS. A separate offshore Design Principles Statement (document reference 21.16 submitted at Deadline 4) sets out the Design Principles that will be adopted in relation to the ORCPs.
2. The design approach is laid out in the Design Approach Document (DAD), whereas this document records the principles that come out of the design review and consultation process. The Project's Planning Statement (document reference 9.1) outlines the Project's compliance with Good Design in accordance with EN-1 (DESNZ, November 2023). How the Project aligns with 'Nationally Significant Infrastructure Projects: Advice on Good Design' (Planning Inspectorate, October 2024) is summarised at Section 1.2 of this DPS.
3. At this stage in the development process, decisions on exact locations of specific components and the precise technologies and construction methods that will be employed have not been confirmed. This includes the exact layout, equipment, and technology of the OnSS.
4. The Project have however developed indicative layouts and designs which have been influenced by their development process and consultation to date. At this stage the indicative designs represent a 'Maximum design envelope' approach, or the 'Rochdale Envelope' approach (The Inspectorate, 2018). This approach assesses what is considered the 'worst case' scenario based on the maximum parameters currently defined for the OnSS. These parameters are outlined in Section 2.1.4 of this document.
5. The key principles which have informed these indicative designs and those that will be adhered to during the detailed design phase of the OnSS are outlined within this document.
6. The design phase of the OnSS is an evolutionary and iterative process that has been subject to the consultation phases undertaken by the Project to date (up to examination stage) and, following this, will be subject to its own phase of consultation by means of a Design Review Process (DRP). This process, its purpose, and the key design decisions and phases that this process intend to influence are set out in the Project's DAD (Document Reference 8.18, version 2). The DAD also summarises the consultation undertaken to date and how this has influenced the contents of this DPS.
7. Detailed design development of the OnSS will take place during 2025. This design will then be finalised, post consent, once a Principal Contractor has been appointed, prior to the start of construction; the key Design Principles that are outlined in this document and that will be updated throughout the DRP will be required to be adhered to, with the final design being subject to approval by Lincolnshire County Council (LCC),in accordance with DCO Requirement 9, prior to the commencement of the construction works.

8. In this respect, the process is similar to obtaining to an outline planning consent under the Town and Country Planning Act that establishes the principle of a development and confirmation that the environmental impact of the development would be acceptable (this is established by the DCO application and ES), with the appearance, transport and layout being reserved matters.
9. This document sets out the key design and landscaping principles and parameters that the Applicant would be required to adhere to when undertaking detailed design for the OnSS. The design and landscaping principles and parameters are secured through the draft DCO and will form the framework for the final design and mitigation (including landscaping) for the OnSS.
10. These design principles will also be applied in combination with the final Ecological Management Plan (EMP) and Landscape Management Plan (LMP), which will be based on the Outline Landscape and Ecological Management Strategy (OLEMS) (document reference 8.1).
11. In order to assist those involved in the design development process, Annex A provides typical examples and information regarding the technology choices, buildings, equipment and infrastructure that comprises a typical substation.

Plate 1.1 The key development phases of the Design Principles Statement (DPS)



1.2 Advice on Good Design

12. The Project's approach to good design aligns with guidance set out in the Planning Inspectorate's recently published 'Nationally Significant Infrastructure Projects: Advice on Good Design' (October 2024), which identifies a good design process as comprising the following six components;
    - *'an effective, intentional, transparent, and deliverable process;*
    - *a collaborative, multi-disciplinary approach including positive community and land rights engagement;*
    - *a succinct and ambitious vision for the project, underpinned by a clear analysis of the context for the place, its environment and the opportunities for creating social value, including for the local and wider economy;*
    - *a clear statement of design principles that will drive the project and deliver wider value and benefits beyond the core purpose of the scheme;*
    - *a narrative that explains how the approach to design has evolved, the reasons for the choices that have been, or will be, made, an explanation of the multiple beneficial outcomes the project will achieve and how they will be secured; and*
    - *design leadership supported by an engaged design champion to ensure design governance is secured and the design principles drive a structured design process and hierarchy of design control.'*
13. The Applicant has been committed to good design from the outset of the Project and fulfils these six components of good design in the following ways.
14. ***'An effective, intentional, transparent, and deliverable process.'*** This document summarises the design processes that guide the Project and the consideration of key design solutions and decisions, it sets out the overarching vision, design principles and commitments, and outlines how these will be implemented through into detailed design. The Applicant is keeping detailed records of all work undertaken as part of the Project, including all meetings, consultation events, site surveys, desk-based studies, consideration of alternatives and development of design solutions. This is to ensure that the process is transparent, is responding to the requirements of the Project and is following an evidence-based approach to deliver the best practicable outcomes.
15. ***'A collaborative, multi-disciplinary approach including positive community and land rights engagement.'*** The Applicant has drawn together a multi-disciplinary team of specialists, collectively covering the breadth of disciplines relevant to the Project and with invaluable experience of working on similar NSIP projects. The specialists have worked collaboratively with the client team, engineers and each other to ensure a holistic and systems-wide approach.

16. The Applicant has also implemented a comprehensive programme of community and landowner engagement, to ensure all parties are being kept well informed and up-to-date with the progress of the Project and provided the opportunity to contribute meaningfully to the refinement of the Project.
17. ***'A succinct and ambitious vision for the project, underpinned by a clear analysis of the context for the place, its environment and the opportunities for creating social value, including for the local and wider economy.'*** The DAD (Document Reference 8.18) sets out the overarching vision for the Project which states "*Our next generation offshore wind farm will help form the backbone of the UK's net zero energy system, engaging communities, delivering opportunities, and empowering transformational environmental change."* This vision expresses the nationally significant role of the Project in delivering green energy and also its locally significant role in delivering positive change within the local community. For example, the Applicant has organised six rounds of engagement with the Community Liaison Groups and aims to continue with regular meetings going forward.
18. ***'A clear statement of design principles that will drive the project and deliver wider value and benefits beyond the core purpose of the scheme.'*** Section 3 of this document sets out the specific design principles that will be delivered in respect of the Project and with reference to the National Infrastructure Commission's four key considerations; climate, people, place and value. In total, there are 17 design principles with activities set out that will enable their implementation.
19. ***'A narrative that explains how the approach to design has evolved, the reasons for the choices that have been, or will be, made, an explanation of the multiple beneficial outcomes the project will achieve and how they will be secured.'*** Ongoing careful and accurate documentation of all Project stages is being undertaken by the Applicant. The DAD (Document Reference 8.18) and this DPS present a narrative that explains how the approach to design has evolved and will continue to evolve and how the multiple benefits of the Project will be secured through the draft DCO. The documentation of the siting of onshore and offshore infrastructure is presented in Chapter 4 of the ES – Site Selection and Alternatives.
20. ***'Design leadership supported by an engaged design champion to ensure design governance is secured and the design principles drive a structured design process and hierarchy of design control.'*** The Project has appointed a Design Champion for the Project who will ensure effective governance around the implementation of good design, by making sure the design principles are fit for purpose, the structured design process enables the optimisation and implementation of the design principles, and that the design review process leads to a robust and defensible outcome.
21. 'Advice on Good Design' (October 2024) is also referenced in the DAD (Document Reference 8.18) in respect of the process of good design and how it will be delivered through the ongoing design review process.

2 The Onshore Substation (OnSS)

2.1 Engineering Design Factors

2.1.1 Need for and purpose of an onshore substation

22. The purpose of the Project is to generate electricity from wind power offshore, bring this power ashore and feed it into the UK National Grid, operated by NGET. The electrical transmission infrastructure required includes offshore substation platforms, offshore export cables, a landfall and transition joint bays and buried onshore cables leading to the Project's confirmed connection point. It is anticipated to generate renewable electricity equivalent to the annual electricity consumption of over 1.6 million households and will play a critical role in achieving the UK Government's ambition to deliver 50 GW of offshore wind by 2030 and to achieve net zero by 2050.
23. An essential component to enable the grid connection is a substation and associated enabling works, at or close to the point where the project connects to National Grid's transmission system.
24. The onshore substation performs several functions, in order that the connection can comply with the requirements of the NGET Grid Code, which regulates connections, and can be summarised under the following headings:
    - Switching – controlling, connecting, protecting and disconnecting the project circuits between the Project and NGET.
    - Voltage alignment – raising the voltage of the transmission system (either 220 or 275kV) to the operating voltage of the NGET system (400kV).
    - Power 'quality control' - in relation to factors including active and reactive power, phase balances and voltage and oscillation frequency, required to meet the standards required for the connection into the National Grid.

2.1.2 Functional Requirements

25. The OnSS is an essential component of the network, housing hazardous equipment. Functionality, reliability and safety are essential to the design which must comply with appropriate technical and safety standards, including the obligations placed on the designer and principal designer under the Construction (Design and Management) Regulations (2015).

2.1.3 Key Considerations

26. The Project has and will continue to take consideration the following key principles relating to substation design as identified by National Grid in the Horlock Rules[1]:

[1] https://www.nationalgrid.com/sites/default/files/documents/13796-The%20Horlock%20Rules.pdf

- The siting, orientation and layout of a substation will look to take advantage of existing screening provided by the topography and vegetation, in combination with an assessment of the receptors in the area surrounding the site.
- Consideration will be given to the positioning of buildings which can provide screening of external equipment and noise attenuation where appropriate.
- The external design, materials and colour of buildings and fencing can be adapted to be appropriate within the local area.
- Access to the site, both for construction and operational traffic is essential and needs to be considered at an early stage of the site selection process and any necessary works need to be included in the design process.
- The use of lightweight, narrow materials and lattices for high level external structures, such as gantries is preferable to solid designs and should be used where practicable.
- The requirement for landscaping will be considered at an early stage as an integral part of the design process and an indicative landscaping plan included with the consent application.
- The interface with NGET and the NGET requirements which will influence the overall layout, will be incorporated into the design as early as possible.
- Consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements for new developments against the consequential environmental effects in order to keep adverse effects to a reasonably practicable minimum.

2.1.4 Maximum Design Parameters

27. The design of the OnSS will be developed during 2025 and finalised post-consent within the maximum design envelope defined in the DCO and assessed in the ES. The assessments in the ES have been based on the MDS for two different types of technology options, which remain under consideration by the Project, which are Air Insulated Switchgear (AIS) and Gas Insulated Switchgear (GIS) (for further information, see Section 2.2). The Project's maximum design parameters for each of these technology options are outlined in Table 2.1.

Table 2.1: Maximum Design Parameters for the OnSS

Parameters	Design Envelope
Maximum number of onshore substations	1
Maximum OnSS footprint (up to fenced perimeter) (AIS) (m^2)	144,000
Maximum OnSS footprint (up to fenced perimeter) (GIS) (m^2)	72,600
Indicative OnSS temporary construction compound area (m^2)	40,000
Maximum duration temporary OnSS construction compound (months)	36
Indicative OnSS temporary commissioning compound area (m^2)	5,400
Maximum duration temporary OnSS commissioning compound (months)	15
Maximum building/ equipment height (AIS) (m)	13

Parameters	Design Envelope
Maximum building/ equipment height (GIS) (m)	16.5
Maximum lightning protection height (m)	30

28. The Project have included the Landscaping in the Project design (refer to Chapter 28 Landscape and Visual Impact Assessment (document reference 6.1.28) and the DAD (Document Reference 8.18).
29. The landscaping comprises of an “onsite” landscaping perimeter that surrounds the OnSS and several “offsite” landscaping strips that are in the surrounding fields and follow existing field boundaries. The proposed landscaping areas are generally alongside open drains into which the field land drains discharge. It is anticipated that the existing land drainage systems within the landscaping areas may require modifications to reduce the likelihood that the drainage systems of the fields would be impacted by the planting and therefore allowance for drainage works has been included in the Order Limits.

Table 2.2: Maximum Design Parameters for the Landscaping

Parameters	Design Envelope
Maximum Footprint of onsite landscaping (m^2)	100,170
Maximum Footprint of offsite landscaping (m^2)	102,900

2.2 Technology Options

2.2.1 Switchgear Technology Options (AIS / GIS)

30. Two primary options exist for the switchgear element of the substation and the selection of the technology will result in designs with different characteristics. The selection of the technology may not be made until the final detailed design is carried out post-consent and therefore both options have been included in the consent application. The selection is between external or internal switchgear, using external Air Insulated Switchgear or internal Gas Insulated Switchgear.

2.2.2 Indicative Layout(s)

31. The indicative layouts for AIS / GIS are presented as 3D-models in Plates 2.1 and 2.2. The GIS footprint is approximately 50% of that for the AIS layout.

AIS Indicative Model

32. An AIS layout (Plate 2.1) been developed which is based on the MDS parameters as outlined in Section 2.1.4.
33. The generic layouts will have to be adapted following site selection to reflect the site position, particularly the cable entry and exit locations and the access point.

34. The 3-D model (Plate 2.1) below represents an indicative layout, and shows how the site can be broadly divided between the yards containing:

- 220-275kv external switch gear yard and external equipment with firewalls
- The Statcom buildings and control rooms
- The 400kV grid transformers and firewalls
- The 400kV external switchgear

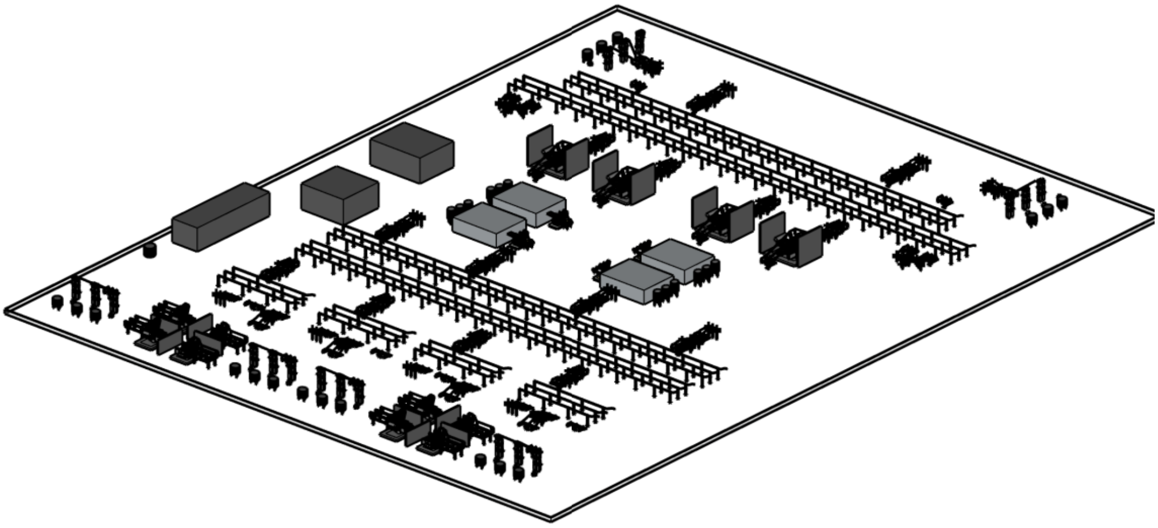


Plate 2.1 Typical 275/400kV AIS 3D Model

GIS Indicative Model

35. The equipment footprint for the GIS option is approximately 50% of that required for AIS. The footprint for the STATCOMs and Transformers will be similar to that for the AIS layout, but the two external switchgear yards, are replaced by one or two GIS buildings. The scale of the 3-D model does not reflect the difference in the footprint of the two options.

36. The 3-D image in Plate 2.2 shows two separate GIS building, for the 220-275kV and 400kV switch gear. The GIS buildings in this layout each have a footprint of approximately 70m x 30m and a maximum height of 16.5m, which incorporates the control rooms. Four separate STATCOM buildings are shown.

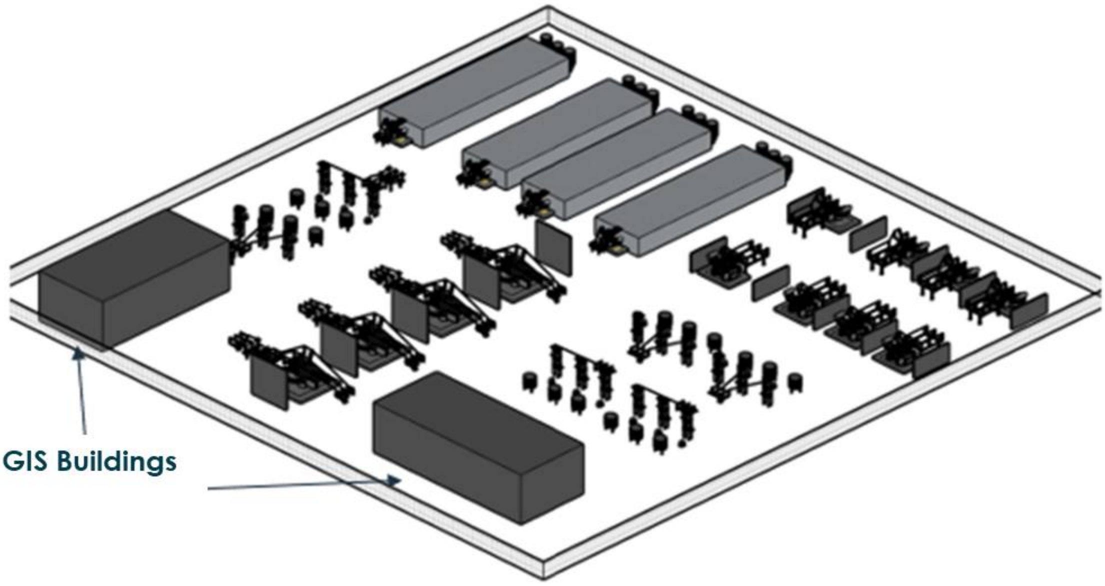


Plate 2.2 Typical 220-275/400kV Equipment and GIS 3D Model

2.2.3 National Grid Interface

37. The OnSS will contain the electrical components that are needed to transform and convert the power from the wind turbines to match the power in the National Grid Transmission System. The Project's precise connection point will be the National Grid substation (NGSS) that will be developed by the National Grid. The OnSS will connect into the NGSS using 400kV cables, which are part of ODOW's infrastructure.
38. While the precise location of the NGSS is not yet defined, the Project have assessed an indicative search area for this infrastructure referred to by the Project as the "Connection Area".
39. The NGSS will be built, owned, and operated by NGET and will be subject to its own consenting process. The NGSS is in an earlier development phase than the Project and underwent its initial non statutory consultation phase in January 2024.
40. The Applicant will continue to engage with the National Grid as their design develops and so the development of the Project's detailed design can be progressed in relationship to the design of the NGSS.
41. Figure 3.1 outlines the Project's order limits for the OnSS in relation to the indicative connection area and the existing overhead lines.

3 Design Principles Adopted

3.1 Key Onshore Design Elements

42. The design and delivery process adopted for the OnSS can be summarised as follows:

- Engagement with local communities and stakeholders during the pre-application stage regarding the onshore substation visualisations (iterations of which were provided at both Phase 2 and Autumn Consultation phases);
- Publication of an Outline Design Principles Statement at Phase 2 Consultation;
- Consultation on landscaping proposals at the Autumn consultation alongside visualisations, a 3D virtual model and Landscaping Consultation document with proposals on plant species;
- Establishment and Phase 1 kick off for the Local Design Review Panel prior to DCO Application (see Design Approach Document) including the commitment to an external design review;
- A Substation Community Liaison Group Meeting was held in July 2024, after submission of the DCO application. As well as providing attendees with project updates, the meeting included a session on the design review process, which included attendance from the Design Review Panel (DRP), who had been appointed to provide external feedback on the onshore substation design. The session covered the process of design review, onshore substation technology options, planting proposals and feedback from the external review undertaken by DRP;
- As outlined in the DAD, continued input from stakeholders through the design review process during detailed design.

43. The design principles are outlined in Section 3, categorised in line with the four design principles to guide the planning and delivery of major infrastructure as set out in 'Design Principles for National Infrastructure' (National Infrastructure Commission, February 2020).

Plate 3.1 The Four Design Principles for National Infrastructure (National Infrastructure Commission, February 2020).

Table 3.1 Design Principles to be adopted

Ref	NIC Design Principle	Applicant's Design Principle	Activity
1	People and Value	Safety	Safety of the public and operatives is an overriding principle that must be given the highest priority when making every design decision.
2	People and Value	Functionality and Reliability	The design of all components shall be functional and fit the purpose of maximising the generating capacity within the technical, environmental and energy affordability constraints of the Project, supporting the reliability and certainty of the power supply to the network and to displace carbon emissions helping to meet national and international carbon reduction targets, in line with the project objectives.
3	People and Value	Reduction of visual impact of the onshore substation (OnSS)	The siting process of the OnSS, while also taking consideration of other key environmental and engineering consideration, selected the site with the best opportunity to provide effective screening, The DPS process will consider a range of design aspects and the objective of reducing visual impact will be a guiding principle of the process.
4	Place	The visual impacts of the substation infrastructure will be minimised as far as possible by their sensitive placing, the use of appropriate design, building	The site selection process sought to position the OnSS where it could be effectively landscaped. Building materials, building shape and colours have been identified as design aspects to be developed with the DRP. The consultation responses received by the Applicant over the pre-application period have referenced the preference for the OnSS to be sufficiently screened. This was further substantiated

Ref	NIC Design Principle	Applicant's Design Principle	Activity
		materials, shape, layout, colour, finishes and landscaping.	during the LDP Meeting 1 In February 2024. The Applicant will pursue opportunities to create a distinctive place that delivers beneficial spatial outcomes for the local community in line with the DRP. The Project will also pursue opportunities to explore whether, taking consideration of the existing land use of the area and the landowner agreements in place, within this newly created environment (the planting scheme), there are further opportunities for local benefit such as; public art; signposting and interpretation facilities.
5	People and Value	Operational equipment and mitigation measures will be designed and installed to maintain agreed noise levels at residential properties.	The selection of equipment and the need for additional noise mitigation measures in the design, will be informed by the environmental assessment and any limits required by the LPA and set in the DCO. Where necessary, noise mitigation will be incorporated into the design.
6	People and Value	Parish Councils, local residents and relevant planning Authorities will be represented in the design development and consultation process	The Project has an established network of 'Community Liaison Groups' (CLGs) that it has consulted with regularly during the project's development stage alongside a series of Public Information Days (PIDs) that have been undertaken at each (non-targeted) consultation phase for members of the public. The Project has also established a 'Local Design Review Panel' focussed on the area surrounding the OnSS however intend to keep the public informed as the design review process evolves by means of newsletters and updates to the project website.
7	People and Value	Establish a DRP that includes experts in the field of	The proposed makeup of the DRP includes members of the project team and their consultant representatives including the appointed landscaping technician, as well as local authority

Ref	NIC Design Principle	Applicant's Design Principle	Activity
		environmental topics that can be influenced by the design process.	appointed LVIA experts, LCC appointed LVIA experts as well as Parish, Local and County councillors. The 'Autumn Consultation' carried out in October 2023 included a request for feedback from the public and landowners regarding the Project's visualisations and indicative landscaping proposals. This feedback influenced the refinements of these proposals that supported the DCO application.
8	People and Value	Commit to an external design review.	As set out in the updated Design Approach Document (DAD) (Document 8.18, version 2), an external independent review of the onshore substation design was undertaken in June 2024. The outputs of this review are detailed in Section 5.4 of the DAD. The Project has committed to having a further external review of the OnSS design, during the detailed design phase.
9	People and Value	Appoint a 'Design Review Champion' who has seniority within the organisation.	The project has appointed its Project Director (David Few) as the Design Champion.
10	Climate, People, Place and Value	Consider 'Good Design' in line with the requirements of Overarching National Policy Statement for Energy (NPS EN-1) and the National Infrastructure Commission's 'Design Principles for National Infrastructure' (National	The Advice on Good Design from the Planning Inspectorate, Criteria for Good Design from EN-1, and objectives of Climate, People, Places and Values from the PINS Design Principles guide are key to the process to develop the principles in this table.

Ref	NIC Design Principle	Applicant's Design Principle	Activity
		Infrastructure Commission, February 2020)	
11	Climate, People, and Place	Incorporation of ecological enhancement considerations within the adopted landscaping scheme to maximise the habitat creation on the site	The project's ecologist has worked with the landscape architect and, coupled with that informed by feedback and that received from the design panel review process to date an Outline Landscape and Ecological Management Plan has been submitted alongside the DCO Application and reinforces the development of a design that integrates opportunities for ecological preservation and enhancement.
12	Climate	The design will optimise generation of renewable energy to displace carbon emissions and help meet national and international carbon reduction and renewable energy targets, in line with the project objectives	The purpose of the project is to generate renewable electricity and export it to the National Grid. The technical design of the substation will minimise electrical power consumption and other losses to optimise the power delivered to the grid.
13	People, Place and Value	Develop an integrated design	By establishing the DPS, this will create a forum, bringing together engineers, landscape architects, external specialists (such as design architects, environmental specialists, local planning representatives, environmental stakeholders and local community representatives). The project believes that in this way the whole range of design aspects and interactions can be considered and integrated.

Ref	NIC Design Principle	Applicant's Design Principle	Activity
Associated Activities to Deliver the Design Principles			
14	Climate, People, and Places	Use of landscape planting to minimise visual effect and maximise screening opportunities	The ability to landscape the site and the existing screening is a major factor in the selection of the site. The Project's landscape architect has produced an indicative landscaping layout which has been included in the order limits of the Project's application and includes both on and off-site planting areas.
15	Climate, People, and Places	The evaluation of the use of bunds to support visual screening	There is potential for surplus excavated material to be formed into bunds and this will be considered as part of the landscaping scheme with the DRP, noting that certain types of landscape planting are not always compatible with bunds.
16	Climate, People, and Places	The establishment of native Woodland to enhance the surrounding area.	The layout of the landscaping aimed to follow natural field boundaries and existing hedgerows to reduce the severance to the grade 1 agricultural land that surrounds it. This comprises approximately 130,000 trees and 1.6 miles of hedgerow, which act as both an effective screen removing all significant visual impacts (after 15 years), these have the added benefit of storing carbon, hosting wildlife, replenishing and restoring soils, the protection of surrounding farmland from soil erosion and providing additional flood protection. The selection of species for planting will be an aspect to be agreed through the DPS process and there will be a strong emphasis on the use of native species.

Ref	NIC Design Principle	Applicant's Design Principle	Activity
17	Climate and People	Design the drainage scheme to avoid increasing flood risk or discharge rates to watercourses.	The drainage scheme will incorporate measures to reduce the site discharge rate to less than the existing level and modelling will be used to inform the design of the flood protection measures.

3.2 The Location of the OnSS, associated infrastructure and landscaping (Order Limits)

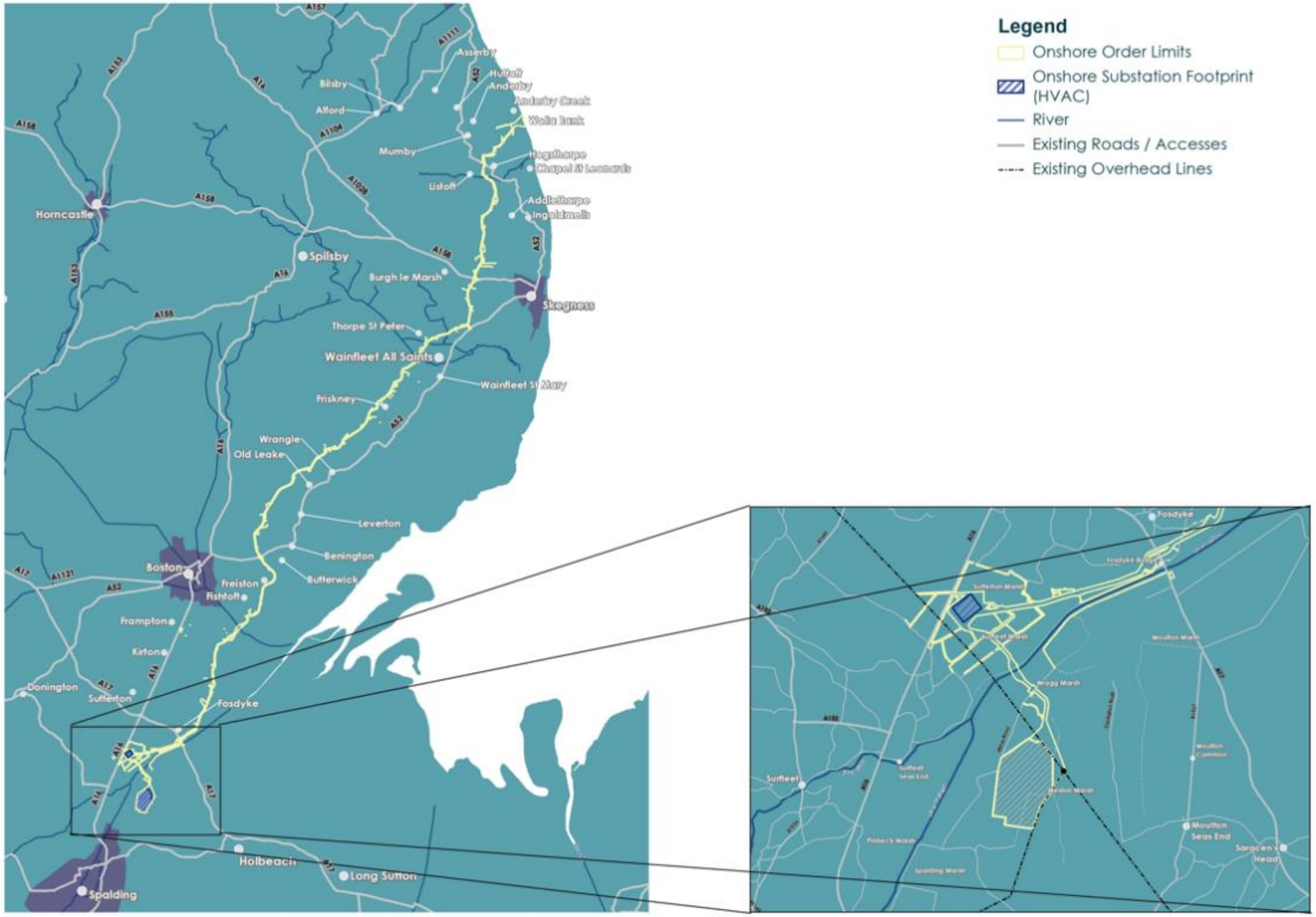


Figure 3.1 The Location of the OnSS

Figure 3.2 The OnSS site and Landscaping Boundaries

3.3 Design Elements Maximum Design Envelopes

44. Information in relation to technical requirements and typical examples of the appearance of substation buildings, external equipment and infrastructure are given in Annex A 'Design Principles Annex A – Typical Information'. This provides a level of background information regarding the typical components that comprise a substation.
45. The key parameters and design aspects for these components are discussed throughout this section. The DAD (Document Reference 8.18) sets out the approach to the design, which aligns with 'Nationally Significant Infrastructure Projects: Advice on Good Design' (Planning Inspectorate, October 2024) . Consultation materials which outline the options for design development, such as colour, cladding and lighting (such as the presentation provided during the DRP1 kick off meeting and the updated visualisations which were presented at DRP2, are shown in Annex A and B of the DAD.

3.3.1 Buildings

Key Design Principles

46. The key parameter, defined as a maximum within the DCO is the overall building height. This will be confirmed at the detailed design stage within the defined parameters and other aspects of the building design will be in accordance with the design principles established through the design review process. Building design aspects will be considered in line with the principle of reducing visual impact and the feedback as received during consultation in relation to preferences for materials and achieving an integrated design.

Parameters	Design Envelope
Maximum building/ equipment height (AIS) (m)	13 (defined in the Project Description (document 6.1.3))
Maximum building/ equipment height (GIS) (m)	16.5 (defined in the Project Description (document 6.1.3))

47. The specific number of buildings for each technology type will not be confirmed until detailed design stage, however, the design of these buildings will be subject to the maximum parameters as identified in Key Design Principles.
48. The key parameter, defined as a maximum within the DCO is the overall building height. This will be confirmed at the detailed design stage within the defined parameters and other aspects of the building design will be in accordance with the design principles established through the design review process. Building design aspects will be considered in line with the principle of reducing visual impact and the feedback as received during consultation in relation to preferences for materials and achieving an integrated design.

Key Design Aspects

49. The key aspects for which principles can be established are:

- **Building positioning and orientation:** This will be predominantly controlled by the technical, operational and safety requirements of the OnSS which will aim to minimise land-take, landscape and visual impacts. The size of the buildings will be based on what is technically required, and no larger than the maximum parameters defined by the DCO.
- **Roof design**: Several options exist for the design of the building roof, which include:
  - **Flat roof:** considered straightforward to construct, allows safe access for maintenance and has low visibility. However, this roof type presents issues such as higher frequency of maintenance requirements, increased risk of water ingress and have slightly higher wall (compared to an apex pitch roof)
  - **Apex roof**: offers durability against harsh weather, effective drainage and increased internal space. However this roof type has reduced accessibility for maintenance, more complex installation and the roofline is a familiar feature of the rural landscape as apex pitch roofs are used on the majority of farm and industrial sheds in the surrounding area
  - **Mono-pitch roof**: allows for good water run-off on one side and features a simpler profile than apex roofs. However, this design can lead to uneven weight distribution, provides less internal space than an apex roof and is susceptible to disproportionate wind uplift on the higher side.
  - **Curved**; Can be visually aesthetic, promotes efficient water run-off and can provide improved structural integrity. However, curved roofs are complex to construct and costly to design as they are built with specialised fabrication required. Curved roofs also have higher visibility, are unfamiliar in the rural landscape and present significant challenges for maintenance and repair work.
- **Cladding material:** Options exist for the material and profile used to clad the building, subject to these complying with operational, maintenance, electrical safety and fire requirements; The four cladding materials that have been considered by the Applicant in their materials analysis include masonry, timber, pre-cast, and pressed sheet steel.
- **Cladding colour:** The colour of the cladding can be agreed within the range of commercially available options. The principle purpose in selecting colours and finishes for the AIS or GIS buildings is to ensure they appear well integrated within their landscape setting. An initial study regarding colour selection for the onshore substation buildings has been carried out and is presented in Annex A and B of the DAD (Document 8.18, Version 2). Visualisations illustrate the application of 'Khaki Green', 'Camouflage', 'Beige Grey', and 'Olive Green' from the Kingspan colour range and the effects these have on the appearance of the onshore substation buildings. While the visualisations illustrate the application of a single colour, alternative options include the use of different colours on different facades in response to the differences in natural light, the gradation of colour horizontally or vertically across the buildings, or the application of a colour pattern that could be used to relate the buildings to their landscape setting or express a particular design concept ; and
- **Elevation finishes**: There will be a co-ordinated approach to the options for the finished appearances of external fittings, such as doors, rainwater goods, steps and handrails. The required functional principles will be applied to ensure robust design andthe external finishes will be designed to reflect the overall design of the AIS or GIS buildings, including material selection and colour choices

3.3.2 External equipment

50. External equipment is required in both the AIS and GIS layouts; this typically comprises external switchgear and gantries, plus large 'solid' individual items such as transformers and static compensators, and smaller items such as harmonic filters. The requirement for transformers and other power quality equipment will be the same for either option, but AIS technology will involve a larger external switching equipment area compared with GIS (which would replace the switching yard with switches housed in a building).

Key Design Principles

Parameters	Design Envelope
Maximum equipment height AIS & GIS (m)	13 (defined in the Project Description (document 6.1.3))

Key Design Aspects

51. The overall layout of the external equipment will be dictated by technical requirements such as: **Equipment siting and orientation Equipment colouring**.

The detailed design of the external equipment will be subject to the confirmation of the chosen technology type.

3.3.3 Noise attenuation

52. The requirements for noise attenuation have been predicted through noise modelling carried out as part of the EIA process, to reduce operational noise levels at sensitive receptors. The assessments have been based on 'typical' noise emission data and the assessment predicts that it is probable that mitigation measures will be required to achieve a 10 decibel (dB) reduction for the following external equipment, from the assumed unattenuated rating.

External equipment	Possible noise attenuation measures
275/400kV Super-grid transformers	Acoustic enclosures
275kV Harmonic filters	Equipment covers or screens
400kV Harmonic filters	Equipment covers or screens

53. The objective is to reduce the noise emitted from external equipment as close as possible to the source and there will be a limited number of technical options to achieve this objective. An Operational Noise Management Plan is required to be submitted for approval prior to construction as part of the pack of final design documents, which will reflect the detailed technical specification of the actual equipment being deployed It may be possible to look at the equipment configuration to receptors or procure equipment with a lower noise emission level, compared with the assumptions used for assessment, which may reduce or remove the requirement for additional mitigation.

Key Design Principles

54. The key design parameters for noise will be set as limits in the DCO. The maximum height limit for any noise mitigation equipment will be the same as for external equipment. The indicative design will include attenuation measures informed by noise modelling in the ES to achieve the appropriate limit at receptors through an integrated design. The final design will be based on the actual equipment to be deployed.

Parameters	Design Envelope
Noise mitigation measures (established through noise modelling of specified equipment to comply with levels assessed in the ES and set as limits in the DCO).	Likely attenuation measures are outlined in the ES and Section 3.3.3. Structures must comply with the height limits for external equipment.

Key Design Aspects

A number of options exist for noise screening, depending upon the type of equipment to be screened and its location. This can range from enclosing the equipment in an 'acoustic enclosure', the use of acoustic panels or in some cases the use of a soil bund.

3.3.4 Finished Ground Level, Finished Floor Level and Flood Protection

55. The construction of a substation requires a levelled site to form a base from which the substation is built up which is typically formed from imported aggregate. The site 'design level' will be defined by the maximum flood depth, established by modelling and a 'freeboard' to ensure that the site will remain operational under extreme flood conditions.
56. The key design parameters are that the site remains operational in a 1 in 1,000-year repeat probability flood including the appropriate allowances for climate change. To achieve this, all vulnerable equipment will be positioned 300mm above the maximum flood depth. The design must provide the necessary flood protection, whist considering visual impacts, minimising the use of materials and achieving an integrated design.
57. The current assumptions from modelling are that the maximum flood level is approximately 4.1m Above Ordnance Datum (AOD) against the existing ground level of approximately 3.65m AOD. Raising the overall platform to a level of 4.2m AOD would represent a ground level surcharge of approximately 55cm, with equipment plinths and floor levels being raised above the platform to achieve the desired resilience level of 4.4m AOD.

Parameters	Design Envelope
Flood resilience design level	Set at 300mm above the modelled maximum flood depth for all vulnerable equipment, as defined in the OnSS Flood Risk Assessment (FRA) (document 6.3.24.3). Current assumptions are a flood resilience level of 4.4m AOD.

Key Design Aspects

58. The required level of flood resilience can be achieved by several design actions:

- **Overall platform raising**: It is assumed that the whole site platform, will be raised above the maximum flood depth. This involves importing aggregate to build up the ground level and other measures (described below) will be used to raise equipment to minimise the volume of material to be imported. Platform raising also raises the roof level of buildings and other equipment so will be minimised wherever possible.
- **Equipment plinths**: These will be used to raise external equipment, such as transformers, above the site platform to the required level.
- **Finished Floor levels:** These will be set above the platform level.

3.3.5 Exterior Ground Surfaces

59. The exterior ground materials need to provide the necessary functionality for the relevant area.

Key Design Principles

60. The key design parameters are that the finishes in different areas are suitable for the use. Electrical safety is the key consideration for all areas and especially in external equipment areas where electrical safety rules apply. It is unlikely that ground finishes will be visible from outside the site, but if this is the case, the visual impact will be considered along with sustainable drainage objectives.

Parameters	Design Envelope
External ground surfaces	Not defined, but must meet safety and operational requirements

61. There surface finishes of the following areas would be subject to detailed design:

- **Site access roadway** – materials and appearance
- **Site roads** – materials and appearance
- **Car parking areas** – materials and appearance
- **External equipment areas** – materials and appearance

3.3.6 Lightning protection

62. Lightning protection masts are structures placed to intercept lightning and provide a safe route to earth before the lighting makes contact with other electrical components. Lightning protection masts are typically slender metal poles, or lattice towers, extending above the level of other equipment.
63. Lightning protection masts are typically constructed from galvanised steel, set on a concrete base with a connection to a buried earth grid.

Key Design Principles

64. The lightning protection will be designed to provide the required level of protection and will be influenced by the layout and height of the buildings and external equipment. The visual impact of these masts will be considered in line with the principle of reducing visual impacts.

Parameters	Design Envelope
Lightning protection masts	Maximum 30m in height, defined in the Project Description

Key Design Aspects

65. The options foe the lightning protection will be required to achieve the necessary technical performance.

3.3.7 Access and Vehicle Parking

66. During the operational life of the substation, it is possible that any of the components could fail and require replacement. The access will therefore need to be designed to accommodate the vehicles necessary to transport the largest components and crane hard standings are likely to be required and included in the layout.

Key Design Principles

67. The permanent access road and vehicle parking is required for regular operational maintenance but also for major maintenance in the case of a component failure. The visual impact of the access will be considered in line with the principle of reducing visual impacts and sustainable drainage objectives.

Parameters	Design Envelope
Site access and vehicle parking	Defined / Limited as per the DCO Works Plans (document 2.1)

Key Design Aspects

- **Site entrance and signage:** the appearance of the OnSS access road from the highway will be an aspect of the development that will be seen by road users.

3.3.8 Fencing and Site Security

68. The external fencing of the substation is designed to make it safe and secure. A substation contains extreme electrical hazards, and it is essential that unauthorised access is prevented by appropriate high security fencing and security systems. As a minimum, the fencing would comply with National Grid's specifications and guidance by the UK National Protective Security Authority and other Governmental bodies relating to security for critical infrastructure.

Key Design Principles

69. The fencing has to provide the necessary level of security, whilst being visually acceptable, either by design or screening and the principle of reducing visual impacts will apply.

Parameters	Design Envelope
Security fencing	Statutory Requirement for minimum height of 2.4m*

*The Electrical Safety, Quality and Continuity Regulations 2002, Regulation 11

Key Design Aspects

70. The Project will discuss security fencing options, for which the key aspects are:

- **Fence type** – options include steel palisade, mesh panels, razor wire, electrified and inner / outer fences; and
- **Fence colour / finish** – options include galvanised, painted or plastic coated.

3.3.9 Drainage

71. An Outline Operational Drainage Management Plan (document 8.12) has been submitted with the DCO application, outlining the drainage requirements, parameters and the indicative arrangements that are proposed.

Key Design Principles

72. The drainage system will be designed to meet the required discharge rate stipulated by the relevant Internal Drainage Board and the lead Local Flood Authority, which is estimated to be less than the current run-off rate. In line with the principles of 'Integrated Design' this will be incorporated into the site and the landscaping design and potentially include ecological enhancements.

Parameters	Design Envelope
Drainage design	Maximum drainage discharge rate 1.4l/s/ha and an Outline Operational Drainage Plan will be prepared

Key Design Aspects

73. A range of drainage options will be considered in the drainage design, these include -

- The use of permeable surfaces;
- The use of local measures alongside impermeable areas;
- The use of a perimeter swale or ditch; and
- Incorporating water storage capacity into the site platform.

3.3.10 Artificial Lighting

74. The overall artificial lighting strategy will be in accordance with the Outline Operational Artificial Light Emissions Management Plan (document reference 8.11) and will aim to minimise the time for which lighting is used, the area lit, the intensity of lighting and the potential for light spillage.

Key Design Principles

75. The lighting will be designed to provide the required level of illumination, whilst avoiding visual night-time disturbance. The principle of reducing visual impact will apply to both the design of the lighting and the operational regime.

Parameters	Design Envelope
Artificial lighting	Will be defined in the Outline Artificial Light Emissions Management Plan

Key Design Aspects

76. The different options for lightning protection that can achieve the necessary technical performance will be reviewed and include the following considerations:

- **Lightning mast design –** appearance, height, design;
- **Low / Ground level lighting –** appearance, height, design; and
- **Operational / security lighting regime.**

3.3.11 Landscaping

77. The design of the landscaping scheme is a primary design aspect and has been at this stage designed to both reduce the impact of the substation and to enhance the local environment.

Key Design Principles

78. The landscaping scheme including the 'onsite' and 'offsite' areas will be located within the order limits and within the overall site area. The key principles relating to this are the reduction of visual impacts and the integration of different aspects of the design.

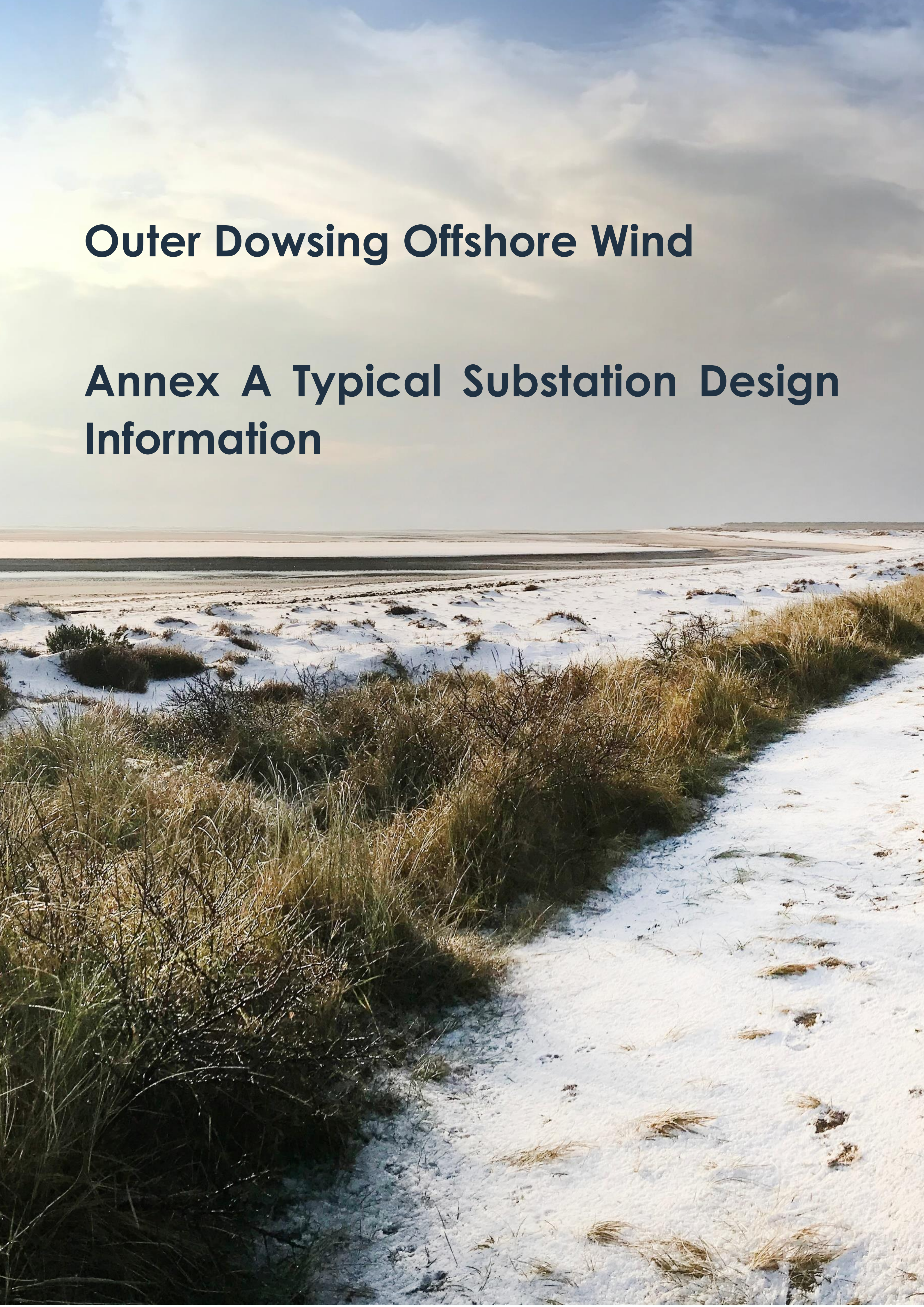
Parameters	Design Envelope
Landscaping areas	Landscaping areas are defined within the Order Limits Figure 3.2.
Landscaping and Ecological management	The Outline Landscape and Environmental Management Strategy (OLEMS) secures the commitment to ensure the species agreed on are ecologically biodiverse in relation to the local area and can deliver enhancement of nature corridors.
Species	Native woodland species. The mitigation woodland planting will be designed to comprise a mix of faster growing 'nurse' species and slower growing 'core' species[2].

Key Design Aspects

79. These are considered to be:

- Species selection;
- Planting timing, spacings, protection;
- Incorporation of wildlife habitats; and
- Integration with the drainage design.

[2] Nurse species, will grow quicker and will provide shelter to bring on core species, while the nurse species will be sufficiently fast growing to provide partial screening of the OnSS after 15 years, the core species will outlive the nurse species and provide a preferred native woodland with a more robust structure closer in character to other woodlands associated with the Lincolnshire landscape.



Outer Dowsing Offshore Wind

Annex A Typical Substation Design Information

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1 Introduction

1.1 Typical Information – Purpose of the document

1. This document provides information regarding the typical buildings, equipment and infrastructure that comprise a substation of the type that Outer Dowsing Offshore Wind (ODOW) propose for the Surfleet Marsh Onshore Substation (OnSS) site.
2. It gives an outline of the purpose of the substation, along with some of the technical requirement and maximum parameters for the Surfleet Marsh site.
3. The illustrations are of typical examples, to assist the Design Review Panel to visualise the type of buildings and equipment that are required which will be the subject of the design review process.
4. The document also identifies certain technical requirements that the design will be required to meet.

1.2 The Requirement for an Onshore Substation

5. The purpose of the Project is to generate electricity from wind power offshore, bring this power ashore and feed it into the UK National Grid, or National Grid Electricity Transmission (NGET). The electrical transmission infrastructure required includes offshore substation platforms, offshore export cables, a landfall and transition joint bays and buried onshore cables leading to the Project's confirmed connection point.
6. An essential component to enable the grid connection is an onshore substation (OnSS) close to the point where the project connects to National Grid's transmission system.
7. The onshore substation performs several functions, in order that the connection can comply with the requirements of the NGET Grid Code, which regulates connections, and can be summarised under the following headings:
   - Switching – controlling, connecting, protecting and disconnecting the project circuits between ODOW and NGET.
   - Voltage alignment – raising the voltage of the ODOW transmission system (either 220 or 275kV) to the operating voltage of the NGET system (400kV).
   - Power 'quality control' - in relation to factors including active and reactive power, phase balances and voltage and oscillation frequency, required to meet the standards required for the connection into the National Grid.

2 Technology Options

2.1 Switchgear Technology Options (AIS / GIS)

8. Two primary options exist for the switchgear element of the substation and the selection of the technology will result in designs with different characteristics. The selection of the technology may not be made until the detailed design is carried out post-consent and therefore both options will be included in the consent application. The selection is between external or internal switchgear, using external Air Insulated Switchgear or internal Gas Insulated Switchgear and the options are described below:
9. Air insulated switchgear (AIS) utilises external switching yards, where the air gap between the metallic electrical contacts and the ground provides the necessary insulation. The circuit breakers rely on the distance of separation between the contacts.
10. Plate 3.1 shows an image of typical external AIS switchgear.
11. AIS substations have large external switch yards containing the equipment. AIS switchgear typically includes galvanised vertical supports, with ceramic insulators and high-level cables and connectors.

Plate 3.1 Typical AIS external switchgear (400kV single busbar)

12. Gas insulated switchgear (GIS) technology houses the switchgear inside metal vessels charged with an insulating gas (typically Sulphur Hexafluoride or SF6). The gas insulated switchgear is housed inside a GIS building. The site footprint for a GIS substation is typically reduce to 50% of a comparable AIS substation.
13. The main characteristic of a GIS substation is the requirement for one or two 'main GIS buildings' that house the switchgear, this is not required for an AIS substation. The current layout assumption is that there would be two separate GIS buildings, one for the 220-275kV side and the second for the 400kV side.
14. Plate 3.2below is typical of the internal of a GIS building. In this example, the switching is carried out inside the metal cylinders.

Plate 3.2 Typical 400kV GIS switchgear

3 Design Elements, External Finishes and Typical Examples

3.1 Buildings

15. A GIS substation will require a main building (Figure 4.1) and both AIS and GIS designs will require two control room buildings. For the GIS layout, these can be incorporated into the GIS building.
16. Up to 10 other small buildings may be included in the layout, for example to provide storage and a workshop, two control rooms, four STATCOM buildings.
17. GIS and control room buildings are typically portal frame, steel clad constructions, similar in design to large agricultural, industrial or distribution buildings. Taller buildings are likely to be flat roofed, to reduce the overall height, but where height is less critical, apex or mono-pitch roofs are also options. The 3-D model assumes that the GIS building incorporates the control room, but these could also be separate buildings. The cladding of the portal frame buildings is typically box profile steel sheeting. More options exist for the construction of the smaller buildings.
18. An example of a GIS main building, with a steel portal frame and a shallow pitch, apex roof is shown in Plate 4.1 and is a typical option.

Plate 4.1 Typical GIS building without a control room annexe

19. External steps and fittings are typically made from steel with a galvanised finish. The external colours are typically based on the best colour to help the building blend into the landscape. Light recessive colours, such the grey finish in Plate 4.1 shows a typical option.

3.2 External equipment

20. External equipment is required in both the AIS and GIS layouts; this typically comprises external switchgear and gantries, plus individual items such as transformers.

21. External switchgear is typically constructed from galvanised steel with porcelain or composite insulators (visible in Figure 4.2). The switchgear is raised above the ground by vertical supports and horizontal gantries are typically constructed from galvanised lattice steelwork. The bases of the supports typically sit on concrete plinths.
22. Transformers are the largest individual 'solid' external structures. These are typically located on concrete plinths with concrete fire / explosion barrier walls separating them from other equipment. The bushings on top of the transformers can be of a similar height to AIS switching equipment. Transformers are typically coloured light or dark grey or green.
23. The plinth raises the equipment to provide flood protection, but also incorporates a bunded sump to protect against leakage of the insulating oil.

Plate 4.2 Transformer – typical appearance with a concrete fire wall and a plinth

24. Other smaller items of external ancillary equipment will also be required, and details of these individual components will be included in the design process. This other equipment is typically painted grey or galvanised.
25. Diesel or low-carbon alternative powered backup generators are typically included in the design to provide backup power for the control room, lighting and control functions in the event of a failure or an outage of the normal 'auxiliary power' supply from the Distribution Network Operator (DNO). Generators can either be located externally, within containers or can be housed inside or alongside buildings.
26. The auxiliary power supply from the DNO will typically terminate in a small utility type kiosk, possibly within a small compound. The installation of this power supply and any infrastructure associated with it will be the responsibility of the DNO.

3.3 Noise attenuation

27. Noise modelling has been carried out for all substation options as part of the site selection process and noise levels assessed at all residential properties in order that, where possible, the need for additional noise mitigation can be avoided by site selection.
28. Modelling of the noise levels generated by the substation, using typical noise emission values identifies that noise attenuation will be required, for the transformers and harmonic filters. This could be achieved by installing noise mitigation measures within the substation design. Noise mitigation is generally most effective when applied as close as possible to the source and is therefore typically incorporated into the design.
29. The assessments have been based on 'typical' noise emission data and the assessment predicts that it is probable that mitigation measures will be required to achieve a 10 decibel (dB) reduction for the following external equipment, based on the assumed rating.

External equipment	Possible noise attenuation measures
275/400kV Super-grid transformers	Acoustic enclosures
275kV Harmonic filters	Equipment covers or screens
400kV Harmonic filters	Equipment covers or screens

30. Where necessary, the following measures can be incorporated into the design:
    - Where possible, selecting equipment with a reduced noise emission level;
    - Locating equipment inside buildings or enclosures incorporating sound proofing materials and multiple skins;
    - Installing panels around external equipment or an internal noise fence;
    - Incorporating noise mitigation materials into the perimeter fence; and
    - The use of earth bunds around the site, often incorporated into the landscaping design.
31. The need to incorporate any of these measures will be determined by the noise modelling and assessment process. Figure 4.3 shows an example of a typical acoustic enclosure for a transformer.

Plate 4.3 A typical transformers in acoustic enclosures (grey metal boxes) with concrete fire walls

Plate 4.4 A typical steel panel noise enclosure surrounding a transformer.

3.4 Finished Ground Level, Finished Floor Level and Flood Protection

32. The construction of a substation requires a levelled site to form a base from which the substation is built up which is typically formed from imported aggregate.
33. The final finished ground level will be confirmed at the detailed design stage and the Visualisations and LVIA assessments have been based on a worst-case elevation above AOD.

34. The Finished Floor level for the OnSS will be confirmed following the finalisation of the Project's Flood Risk Assessment (FRA) which will be submitted as part of the DCO Application

35. There are several factors that could influence the maximum finished floor level, including:

- Surface water drainage design requirements, to ensure adequate surface water run-off from the onshore substation and a suitable connection to the existing surface water drainage system;
- Existing ground levels and practicable cut and fill requirements, to optimise the cut and fill balance of the onshore substation and minimise the need to import or export spoil material during the onshore substation construction; and
- Groundwater constraints, to ensure appropriate management and control of groundwater interactions in the design of the onshore substation.

36. ODOW is a Nationally Significant Infrastructure Project (as defined by the Planning Act 2008) and as 'essential infrastructure' is required to be designed to remain operational in a 1 in 1,000-year flood event, including the 'upper end' allowances for climate change, as defined through the Technical Guidance to the Planning Policy Framework, or National Planning Policy Statements (NPPS).

37. ODOW has engaged with the EA to agree the methodology to establish the correct design level for the site, as no suitable existing modelling is available. ODOW has commissioned bespoke modelling of various potential flooding sources and scenarios. The site benefits from the existing EA maintained defences alongside the river Welland, and the modelling established that a breach of these defences, during a 1 in 1000 return probability event, with allowances for climate change, is the scenario that results in the maximum flood depth at the site.

38. The modelling has been submitted to the EA for review and confirmation of the results by the EA's modelling consultant and the Flood Risk Assessment for the OnSS and Modelling Report are included in the DCO application Environmental Statement.

39. ODOW is proposing to set a 'design level', incorporating a 'freeboard' of 300mm above the maximum flood depth and all sensitive equipment will be located at or above this level, in order to comply with the flood protection requirements of the NPSS to remain operational under flood conditions. The detailed design is likely to achieve this through a combination of raising the overall site (the platform), the use of equipment plinths, raising external control boxes and the setting of building floor levels.

40. Based on the provisional modelling results, the current assumptions from modelling are that the maximum flood level is approximately 4.1mAOD against the existing ground level of approximately 3.65mAOD. Raising the overall platform to a level of 4.2mAOD would represent a ground level surcharge of approximately 55cm, with equipment plinths and floor levels being raised above the platform to achieve the desired resilience level of 4.4mAOD.

41. The detailed site design will aim to minimise the overall level of site platform raising, to reduce the volume of material required to form the platform and also to avoid the raising of the overall height of buildings (although a conservative allowance for ground level raising has been included in the production of the photomontages and the assessment).

3.5 Exterior Ground Surfaces

42. The ground finish around external equipment is typically finished in single sized angular stone, pebbles or, in some circumstances, asphalt. The purpose of ground finish is to:

- Increase the touch and step potential for operators reducing the risk of electric shock and discharges to earth.
- Prevent standing water and allow movement of drainage water.
- Increase the resistance between feet and the ground and prevent slips.
- Prevent weed growth.
- Reduce the fire risk from spilt oil.

43. The selection of the type of stone or asphalt will be made as part of the detailed design.
44. Internal roadways will typically be constructed from concrete with upstanding kerbs, although some areas that will only receive light traffic may also be surfaced with asphalt or unbound stone and surfaces will be appropriate for the proposed use and weight loading.

3.6 Lightning protection

45. Lightning protection masts are structures placed to intercept lightning and provide a safe route to earth before the lighting makes contact with other electrical components. Lightning protection masts are typically slender metal poles, or lattice towers, extending above the level of other equipment.
46. Lightning protection masts are typically constructed from galvanised steel, set on a concrete base with a connection to a buried earth grid.

3.7 Access and Vehicle Parking

47. During the operational life of the substation, it is possible that any of the components could fail and require replacement. The access will therefore need to be designed to accommodate the vehicles necessary to transport the largest components and crane hard standings are likely to be required and included in the layout.
48. The substation will be unmanned during the operational stage but will receive regular maintenance visits, requiring safe areas to park vehicles and access routes into the site. The substation layout will be designed to allow safe access to the control room for visiting staff without the need to enter or take vehicles into hazardous areas.

3.8 Fencing and Site Security

49. The external fencing of the substation is designed to make it safe and secure. A substation contains extreme electrical hazards, and it is essential that unauthorised access is prevented by appropriate high security fencing and security systems. OnSS Fencing is typically constructed from galvanised steel, typically using vertical palisades on the external side, with a secondary electrified fence on the internal side.

Plate 4.5 Typical examples of high security external fencing

50. The example above is a high security electrified fence where there is also an outer fence of mesh panels.
51. Within the substation, areas will be separated by fencing to prevent unauthorised or accidental access to hazardous areas for safety. Internal fencing is typically steel mesh panelling or palisades with a galvanised finish.
52. For external fencing, a minimum height of 2.4m is stipulated under relevant electrical safety regulations (The Electrical Safety, Quality and Continuity Regulations 2002, Regulation 11) and this is frequently the height of the steel palisade fence. It is common practice to enhance this fence by adding electrification or additional wire above the palisades.

3.9 Drainage

53. An Outline Drainage Strategy Document will be prepared and submitted with the DCO application as Document 8.12 'Outline Operational Drainage Management Plan'. Drainage features will have a design impact and therefore will be included in the scope of the Design Principles Statement.
54. The design of the surface water drainage system will incorporate mitigation to achieve the required run-off rate for any discharge from the site. Where possible the principles of Sustainable Drainage Systems (SuDS) will be applied to the design of the site, to minimise the volume of rainwater that is collected and discharged. A discharge will be required into a surface water drain and the discharge rate will be established through consultation with the appropriate Internal Drainage Board, who will be responsible for the approval of the discharge.

55. ODOW has engaged with the Welland and Deepings IDB regarding discharging drainage water into the Risegate Eau to the north of the site. ODOW intends to design the drainage system to attenuate the discharge to a rate not exceeding 1.4l/s/ha, which is expected to be lower than the existing run-off rate.

56. The discharge attenuation options will be determined following ground investigations, and it is likely that this will include both storage and infiltration options. The site area will include the necessary space to incorporate the likely number of attenuation bodies required, based upon preliminary assessment. The overall drainage scheme will require the approval of the Lead Local Flood Authority (Lincolnshire County Council). The drainage design process will therefore be carried out in consultation with both authorities.

57. A large proportion of the substation area will likely be surfaced with a permeable finish to allow a degree of infiltration and slow the rate of discharge. In some situations, such as alongside access roads, run-off can potentially be directed into swales or French drains, subject to the space being available and the ground conditions and water table being suitable.

58. The two main attenuation features under consideration are:

- A swale running around the perimeter of the site, between the site fence and the landscaping area. The swale would collect drainage water from the site, allowing infiltration and limiting the discharge rate.
- The use of the platform construction to provide drainage capacity (and infiltration) through design and the use of single sized stone, creating voids for water storage and passage.

59. The detailed design will aim to control the source of surface water as well as managing it and the following measures will be considered in the design:

- Utilising permeable surfacing wherever possible
- Managing surface water as close as possible to the source – e.g., local filtration drains or swales alongside roadways and areas of hard-standing.

60. In addition to the drainage function, a perimeter swale can be designed to enhance the wildlife value of the landscaping area within which it would be located.

61. ODOW is considering a number of drainage strategies which could be considered in the final design:

- Providing 100% of the attenuation through the swale.
- A hybrid system with the swale being the main attenuation, plus some additional capacity from the platform.
- Designing the platform to provide the main attenuation with a smaller swale capacity.

Any of the options could be engineered to provide the necessary drainage attenuation and the optimum design will be developed, following consultation alongside the detailed design and layout for the substation.

62. Certain equipment, such as transformers, are filled with insulating oil and these will likely be located within bunded compounds, where the drainage system incorporates individual oil traps, preventing any oil leakage migrating outside of the confined area. Similar arrangements are typically included for areas of oil storage or where diesel powered generators are located.

63. The drainage of hard-standings, internal roads and parking areas will incorporate an oil interceptor to protect against leakages or spillages within these areas

64. The OnSS is likely to have only a very small operational water requirement during the operational phase but opportunities will be considered for rainwater harvesting, although this is unlikely to have a significant impact upon the overall drainage strategy.
65. The site will require a foul drainage system for the toilet, shower and kitchen serving the control room and a suitable system will need to be incorporated in the design for approval.
66. Options include a septic tank or small package treatment unit, and the design will take account of the ground conditions and discharge options. Foul water volumes are typically assumed to be less than a residential property.
67. The substation drainage plan will be submitted for approval by the local authority as part of the detailed design process, in accordance with the relevant DCO requirement.

3.10 Artificial Lighting

68. The overall artificial lighting strategy will aim to minimise the time for which lighting is used, the area lit, the intensity of lighting and the potential for light spillage.
69. The substation will not normally be illuminated, but lighting will be required for both security and safety purposes, when staff are working within the site or accessing or leaving the control room. Security lighting would be motion activated and the lighting of other areas would only be required when staff are accessing or working at the site during hours of dusk or darkness.
70. Industry standards are available for guidance regarding the appropriate minimum lux levels for different areas within the substation. Typically, the external area of the substation is lit by tubular steel lighting columns with downward facing LED luminaries. Low level lighting may also be required in areas not illuminated by the main lighting. Lights will be designed to minimise light spill.
71. The lighting plan will be developed in accordance with the Outline Artificial Light Emissions Management Plan will be provided as part of the DCO Application.

3.11 Landscaping

72. The design of the substation will take into consideration the existing landscape, including any trees or woodland with a view to retaining these wherever possible. Landscaping will be designed to mitigate visual impacts and impacts on environmental receptors. The landscape design is informed by the landscape and visual impact assessment. Chapter 28 Landscape and Visual Assessment (LVIA) (document 6.1.28) provides examples of how mitigation planting could be utilised to assist with screening of a substation as well as taking consideration of enhancing biodiversity and mitigating impacts on environmental receptors.
73. Landscaping can be installed around the perimeter of the substation or closer to the receptor. For example, planting hedgerows or similar, alongside a road is considered an effective way to screen a substation from view by motorists.
74. An outline landscaping plan has been developed, in order to inform the Landscape and Visual Impact Assessment (LVIA) and also so that the necessary land for landscaping is included in the application order limits. The proposed plan includes 'onsite landscaping', surrounding the site with a woodland planting area, and 'offsite landscaping' of reinforcing hedgerows and establishing strips alongside roads and field boundaries to screen the substation from sensitive locations.

75. Offsite landscaping will typically be installed as early as possible in the construction process, whereas onsite landscaping is usually carried out in the first planting season following site reinstatement.

76. The landscaping will be accompanied by a maintenance plan to ensure that the planting becomes established successfully.