AENC-ARC-CNS-REP-0027

Norwich to Tilbury

Volume 7: Other Documents

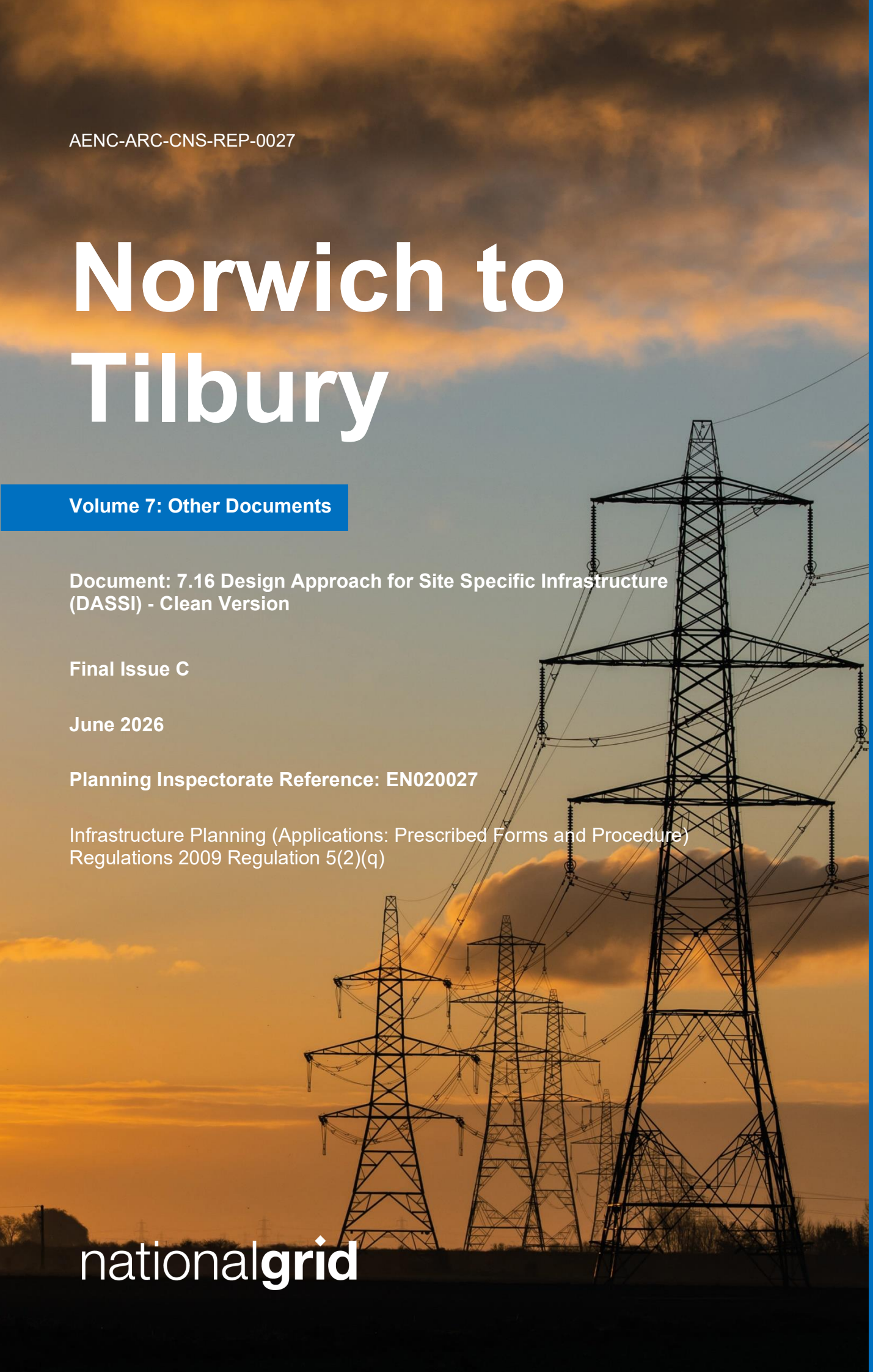
Document: 7.16 Design Approach for Site Specific Infrastructure (DASSI) - Clean Version

Final Issue C

June 2026

Planning Inspectorate Reference: EN020027

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009 Regulation 5(2)(q)



nationalgrid

Revision History

Version	Date	Submitted at
A	29 August 2025	DCO Application
B	12 May 2026	Deadline 4
C	10 June 2026	Deadline 5

Contents

Executive Summary

The primary purpose of the Design Approach for Site Specific Infrastructure (DASSI) is to outline the design guidance that will be taken forward into the detailed design. It sets out an approach to the design of site-specific infrastructure of non-linear works, this includes the proposed substations, works to substations and Cable Sealing End (CSE) compounds as shown in **Figure 6.4.2: Proposed Project Design – Permanent Features [REP4-110]**.

The DASSI supplements the Norwich to Tilbury **7.15 Design and Access Statement (Final Issue B) [REP2-020]** and **5.15 Design Development Report [APP-122]**.

The DASSI provides information on the site location, context and relevant site-specific information for the permanent infrastructure. Examples of existing infrastructure provides images showing existing substations and CSE compounds to highlight variation in design.

The report sets out an explanation of the components of the permanent infrastructure and their operational purpose. The design principles and scope for variation sets out where there is scope for flexibility in detailed design and elements of scope where there is not. National Grid has reviewed the proposed colour palette for the Gas Insulated Switchgear (GIS) building at Tilbury North Substation and landscaping at the CSE compounds and new substations / substation extension, as there is scope to vary these design details.

The report concludes with setting out the DCO requirements and approval process, and details of how the submission made by National Grid's final design must have regard to the DASSI. The DASSI sets out the role of the Design Review Panel which will be invited to review and comment on those design matters set out in the Design Principles section of the DASSI. The DASSI also describes the role of the Delivery and Detailed Design Champion who will oversee the process in support of securing Good Design.

This report provides design principles that should be applied to and details having regard to the DASSI, including all permanent buildings, unless otherwise agreed with the relevant planning authority. This is secured through compliancy Requirement 12. There is also Requirement 11 to agree the final colour of the GIS and gas insulated hall annex with the Local Planning Authority colour of buildings at Tilbury North Substation, which must be submitted for approval to the relevant Local Planning Authority (refer to Schedule 3 of the draft 3.1 DCO (Revision E) for more information), should the Secretary of State be minded to approve the DCO that grants the development consent.

1. Introduction

1.1 Purpose of this DASSI

1.1.1 This Design Approach for Site Specific Infrastructure (DASSI) document has been prepared in support of the application for development consent for the Norwich to Tilbury project (referred to as 'the Project'). It sets out the approach to the design of site-specific infrastructure of non-linear works; this includes the proposed substations, works to substations and Cable Sealing End (CSE) compounds as shown in **Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**.

1.1.2 This document supplements the **Design and Access Statement (DAS) (Final Issue B) [REP2-020]** and **5.15 Design Development Report [APP-122]**.

1.1.3 The **DAS (Final Issue B) [REP2-020]** explains the legislative, policy and physical context within which the design proposals have evolved and the way in which that context has influenced the final proposals. The DAS sets out the design principles applied by National Grid and summarises the approach to good design and describes how the proposals have been influenced by consultation and informed by the design principles.

1.1.4 The **DAS and the 2023 DDR (National Grid, 2023), 2024 DDR (National Grid, 2024)** and **2025 5.15 DDR [APP-122]** are the primary documents referred to for information on the Project's approach to good design and provides an explanation of the main changes in the route alignment, infrastructure siting and technology incorporated into the Project following review and consideration of feedback received since the 2022 and 2023 non statutory consultations and statutory consultation in 2024. The document also addresses some of the main changes requested and those changes raised by a large number of respondents which may have led to a change of the Project design.

1.1.5 The DASSI document focuses on the design principles that led to the development of the layout of the non-linear permanent infrastructure on specific named sites within the geographical areas that the Project has been divided into. These areas are set out below.

1.1.6 The Project has been broken down into eight sections based largely on Local Authority boundaries. The eight sections are described below and presented within the Environmental **Statement Figure 6.1.1: Site Location Plan and Project Sections [APP-125]**.

- Section A – South Norfolk Council
- Section B – Mid-Suffolk District Council
- Section C – Babergh District Council, Colchester City Council and Tendring District Council
- Section D – Colchester City Council
- Section E – Braintree District Council

- Section F – Chelmsford City Council and Brentwood Borough Council
- Section G – Basildon Borough Council and Brentwood Borough Council (and part of Chelmsford City Council)
- Section H – Thurrock Council.

1.1.7 The permanent site-specific infrastructure of non-linear works included in the Project have been listed below, including which section of the Project they are located within:

- Seven new CSE compounds (each with a permanent access) to connect the overhead lines to the underground cables and vice versa:
  - Wenham Grove (Section C)
  - Great Horkesley (East Anglia Connection Node (EACN) Side) and Great Horkesley (Tilbury Side) (Section D)
  - Fairstead (EACN Side) and Fairstead (Tilbury Side) (Section E)
  - YYJ CSE Compound at Tilbury North and Warley Side (Section H)
- A new 400 kilovolt (kV) substation on the Tendring Peninsula, referred to as the EACN Substation (with a new permanent access) (Section C). This is proposed to be an Air Insulated Switchgear (AIS) substation.
- A new 400 kV substation to the south of Orsett Golf Course in Essex, referred to as the Tilbury North Substation (with a new permanent access) (Section H). This is proposed to be a Gas Insulated Switchgear (GIS) substation.
- Additional interfaces including:
  - Connection works into the existing Norwich Main Substation (Section A)[1]
  - Substation extension at the existing Bramford Substation (Section B). The works comprise the installation of 400 kV Full Line Tension (FLT) gantries up to 15 m in height and associated connection/ancillary works within the substation boundary.

1.1.8 This document outlines the design principles that can be taken forward into the detailed design, sets out the approach to the design of site-specific infrastructure of non-linear works, and details those elements of the design which have some flexibility in their appearance and those that do not. The document sets out the approach to which the detailed design will have regard to this and secured through requirements.

1.2 Structure of the DASSI

1.2.1 The DASSI document has been structured to include the following chapters:

- Chapter 1: Introduction – Outlines the purpose of this document, provides background information and design context for the permanent site-specific infrastructure of non-linear works

[1] An extension to Norwich Main substation was approved by South Norfolk Council in September 2024 (Planning reference 2024/1336) to accommodate new infrastructure and additional customer bays.

- Chapter 2: Site Location and Context – Images and descriptions of the sites involved in the Project and relevant site-specific information
- Chapter 3: Examples of Existing Infrastructure – Images showing existing substations and CSE compounds to highlight variation in design
- Chapter 4: DCO Design and Operational Function – Explanation of the components included in the design and their operational purpose
- Chapter 5 – Design Principles and Scope for Variation in Developing the Detailed Design – Design principles and elements of scope that are flexible and those that are not
- Section 6: DCO Requirements and Approval Process – An overview of Design Governance and detail of the Design Review Panel and Design Champions roles in securing good design and how the final design must have regard to the DASSI

1.2.2 When the different types of permanent infrastructure are discussed, the report has been structured to group these together rather than run geographically along the route. This results in all the CSE compounds, substations and then substation works being discussed in turn.

1.3 Background to the Project

1.3.1 The Project is a proposal by National Grid to upgrade the electricity transmission system in East Anglia between Norwich and Tilbury, comprising:

- A new 400 kV electricity transmission connection of approximately 180 km overall length from Norwich Main Substation to Tilbury Substation via Bramford Substation, a new EACN Substation and a new Tilbury North Substation, including:
  - Approximately 159 km of new overhead line supported on approximately 509 pylons, either standard steel lattice pylons (approximately 50 m in height) or low height steel lattice pylons (approximately 40 m in height) and some of which would be gantries (typically up to 15 m in height) within proposed CSE compounds or existing or proposed substations
  - Approximately 21 km of 400 kV underground cabling, some of which would be located through the Dedham Vale National Landscape (an Area of Outstanding Natural Beauty (AONB[2])
- Up to seven new CSE compounds (with permanent access) to connect the overhead lines to the underground cables
- Modification works to connect into the existing Norwich Main Substation and a substation extension at the existing Bramford Substation
- A new 400 kV substation on the Tendring Peninsula, referred to as the EACN Substation (with a new permanent access). This is proposed to be an AIS substation

[2] National Landscape is the rebranded name of an Area of Outstanding Natural Beauty (AONB) from 22 November 2023

- A new 400 kV substation to the south of Orsett Golf Course in Essex, referred to as the Tilbury North Substation (with a new permanent access). This is proposed to be a GIS substation
- Modifications to the existing National Grid Electricity Transmission overhead lines to facilitate the connection of the existing network into the new Tilbury North Substation to provide connection to the Tilbury Substation
- Ancillary and/or temporary works associated with the construction of the Project.

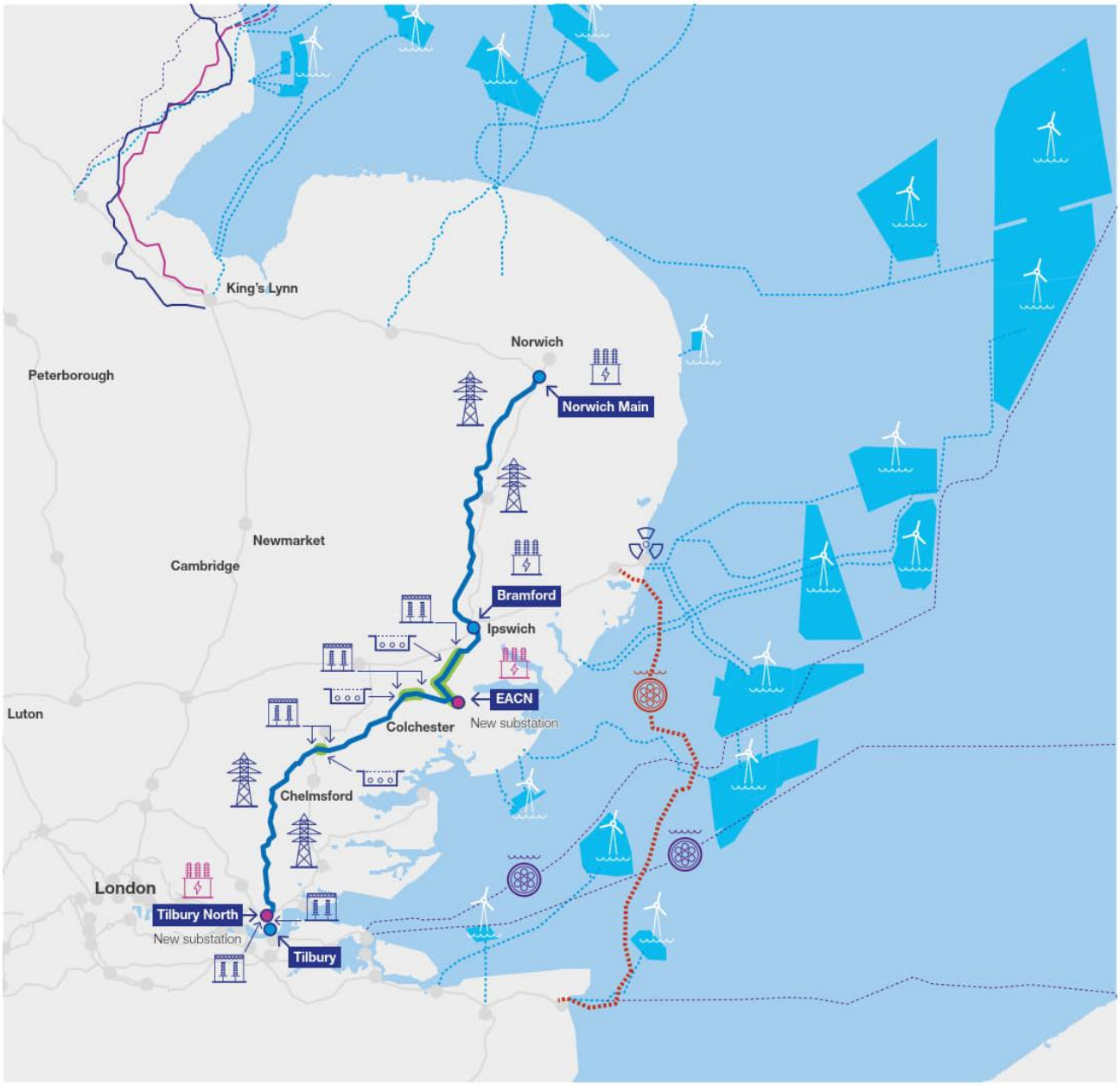
1.3.2 In addition, third party utilities diversions and/or modifications would be required to facilitate the construction of the Project. There would also be land required for environmental mitigation and Biodiversity Net Gain (BNG).

1.3.3 As well as the permanent infrastructure, land would also be required temporarily for construction activities including, for example, working areas for construction equipment and machinery, site offices, welfare, storage and temporary construction access.

1.3.4 The Project would be designed, constructed and operated in accordance with applicable health and safety legislation. The Project will need to comply with design safety standards including the Security and Quality of Supply Standard (SQSS), which sets out the criteria and methodology for planning and operating the National Electricity Transmission System (NETS). This informs a suite of National Grid policies and processes, which contain details on design standards required to be met when designing, constructing and operating assets such as those proposed for the Project.

1.3.5 Image 1.1 shows the locations of the substations, CSEs and overhead lines proposed for the project.

Image 1.1 Geographical Context- Schematic Map



Overview of the Operational Requirements for CSE Compounds

1.3.6 The Project will consist of up to seven CSE compounds, the individual site contexts for each are described in more detail below. CSE compounds are areas accommodating equipment required to allow for the transition from overhead lines to underground cables. They are needed where a section of underground cable carrying electricity ends and the circuit continues onto an overhead line (or vice versa). The CSE compounds typically occupy a footprint of approximately 64 m x 90 m for a 400 kV double circuit. Each CSE compound would have two gantries which are supporting structures (typically 26 m wide with a maximum height of 15 m, with an upward vertical limit of deviation (LoD) of 10%) which connect to the CSE compound via high voltage busbars and other high voltage electrical equipment.

1.3.7 In addition, a small portable relay room (PRR) may be required[3] in each compound, this houses the electrical protection and control equipment if needed. The proposed footprint allows sufficient land to accommodate one PRR per compound. The size of the PRR is the standard National Grid 9 m x 4 m facility.

1.3.8 The CSE compounds have a 15 m maximum height and an upward vertical LoD of 10%. There is no defined downwards vertical LoD for the works to CSE compounds. The lateral and longitudinal LoD are generally 50 m on all sides of the proposed location but vary locally depending on features (hedgerows, watercourses).

1.3.9 The CSE compounds will consist of two circuits with the below equipment:

- 400 kV CSEs (three cables per phase configuration)
- 400 kV surge arresters
- 400 kV earth switches
- Landing FLT Gantry/Low Duty Gantry – 26 m wide
- Post insulators
- PRR (if required)
- Category 3 fence

1.3.10 An electricity supply from a Local Distribution Network Operator (DNO) is not usually required to conventional CSE compounds, especially because such compounds are usually sited in remote areas. No supply is envisaged to be required for any of the CSE compounds proposed as part of this Project. Should a power source be required in the future solar power would be the preferred source.

Fencing

1.3.11 Each compound would be surrounded by security fencing, typically 4 m high, to protect the equipment. No specific requirements are needed for the security fencing around the new CSE compounds, therefore fencing has been designed as Category 3. Category 3 security fencing refers to perimeter security fencing used where full security fencing is not deemed to be required (for example, full security fencing is

[3] Currently there is no locally placed Protection and Control equipment however should this be required the design makes provision for a local PRR.

required at substations) while still meeting the required safety and security requirements.

1.3.12 There would be a minimum 2 m clearance zone around the internal side of the security fence to allow maintenance and access. Some equipment within the compound will require a greater separation distance from the fencing, for example the gantry must have at least a 3.1 m clearance distance.

Lighting

1.3.13 Operational lighting is not required for the CSE compounds; however, task lighting may be required when undertaking specific maintenance activities.

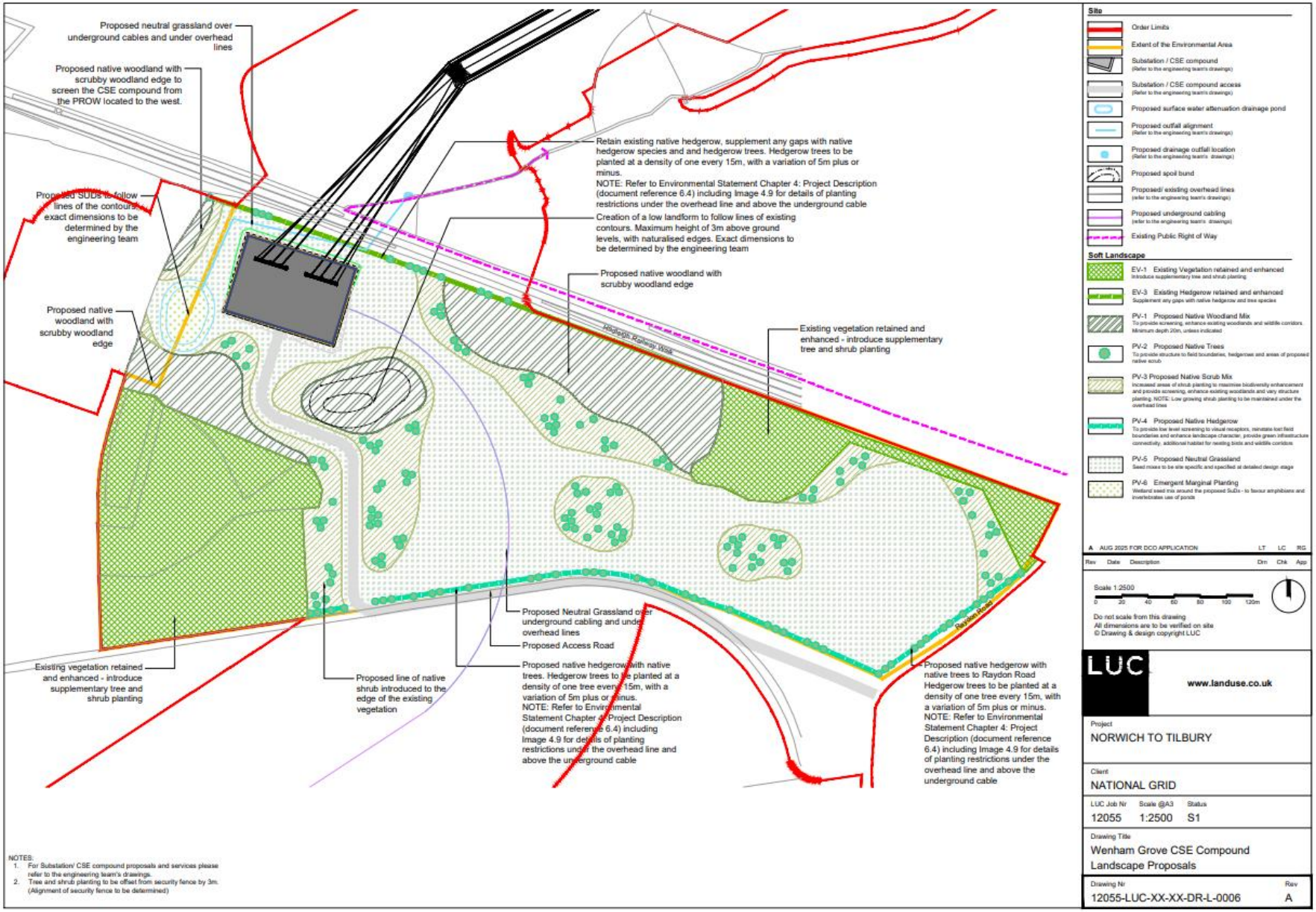
Access

1.3.14 There would be dedicated temporary access for the construction works. A separate permanent access road will be installed to connect each CSE compound to the local road network providing access for operation and maintenance activities. It is assumed these would be constructed using a bound solution (asphalt or concrete pavement); however, this would be determined at the detailed design stage. Access would be typically made to the CSE compounds and substations by foot, using 4 x 4 vehicle, or tractor and trailer.

Wenham Grove CSE Compound

1.3.15 A CSE compound is required to the north of the Dedham Vale National Landscape at Little Wenham to enable the transition from overhead line to underground cable. Drawing 13 of the 2.6.1 Design and Layout Plans – Subs and Cables AENC-MMAC-ENG-DWG-0085) (Revision C) shows the indicative layout of the proposed CSE compound. There will be 'Environmental Areas' located around the new/ extended National Grid permanent assets (i.e. CSE compounds and substations) shown in images 1.2-1.9 below. An indicative landscape design has been created for these areas (Appendix D: 7.4 Outline Landscape and Ecological Mitigation Plan Proposals (Revision B)). A permanent maintenance access is proposed from the east; the LoDs allow for access via a new bellmouth or the upgrading of the existing bellmouth. The design of this will be agreed in consultation with the relevant highway authority as part of an application for formal approval of highway works, in accordance with Schedule 15 (Protective Provisions - Local Highway Authorities) to the draft 3.1 DCO (Revision E). The Order Limits also allow for the removal and reinstatement of the unused existing access road and bellmouth, if not used for permanent maintenance access, following completion of the works.

Image 1.2 Wenham Grove CSE Compound (Source: Appendix D of the Outline LEMP (Revision B)



Great Horkesley (EACN Side) and Great Horkesley (Tilbury Side) CSE Compounds

1.3.16 There has been careful siting of the CSE compounds which are proposed within areas of close proximity to the Dedham Vale National Landscape. These components have been carefully sited taking into consideration Horlock Rules including the potential for landscape and visual effects, and in the setting of the Dedham Vale National Landscape. A CSE compound (Great Horkesley (EACN Side) is required to the east of Great Horkesley to enable the transition from overhead line to underground cable. A permanent maintenance access is proposed from Boxted Road to the north to serve the Great Horkesley (EACN Side) CSE compound.

1.3.17 A second CSE compound Great Horkesley (Tilbury Side) is required to the west of Great Horkesley to enable the transition from underground cable back to overhead line towards Tilbury (see Image 1.4). A permanent maintenance access is proposed from Crabtree Lane to the east to serve the Great Horkesley (Tilbury Side) CSE compound; the temporary construction bellmouth on Crabtree Lane will be retained and modified for permanent operational usage.

1.3.18 Drawings 16 and 17 of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed CSE compounds. The proposed Environmental Areas are shown on Image 1.3 and Image 1.4 (Appendix D of the 7.4 Outline LEMP (Revision B)).

Image 1.3 Great Horkesley (EACN Side) Compound (Source: Appendix D of the Outline LEMP (Revision B))

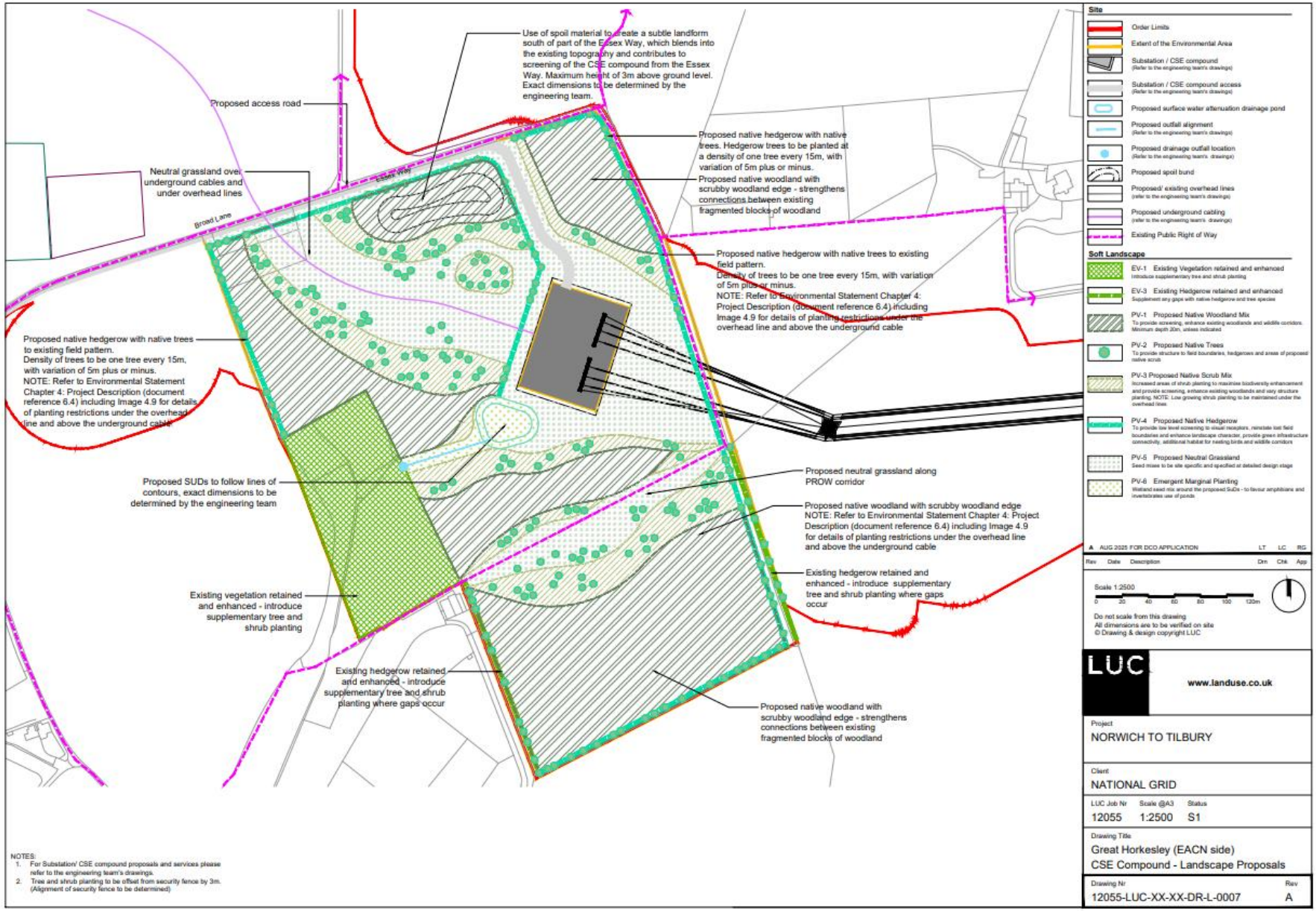
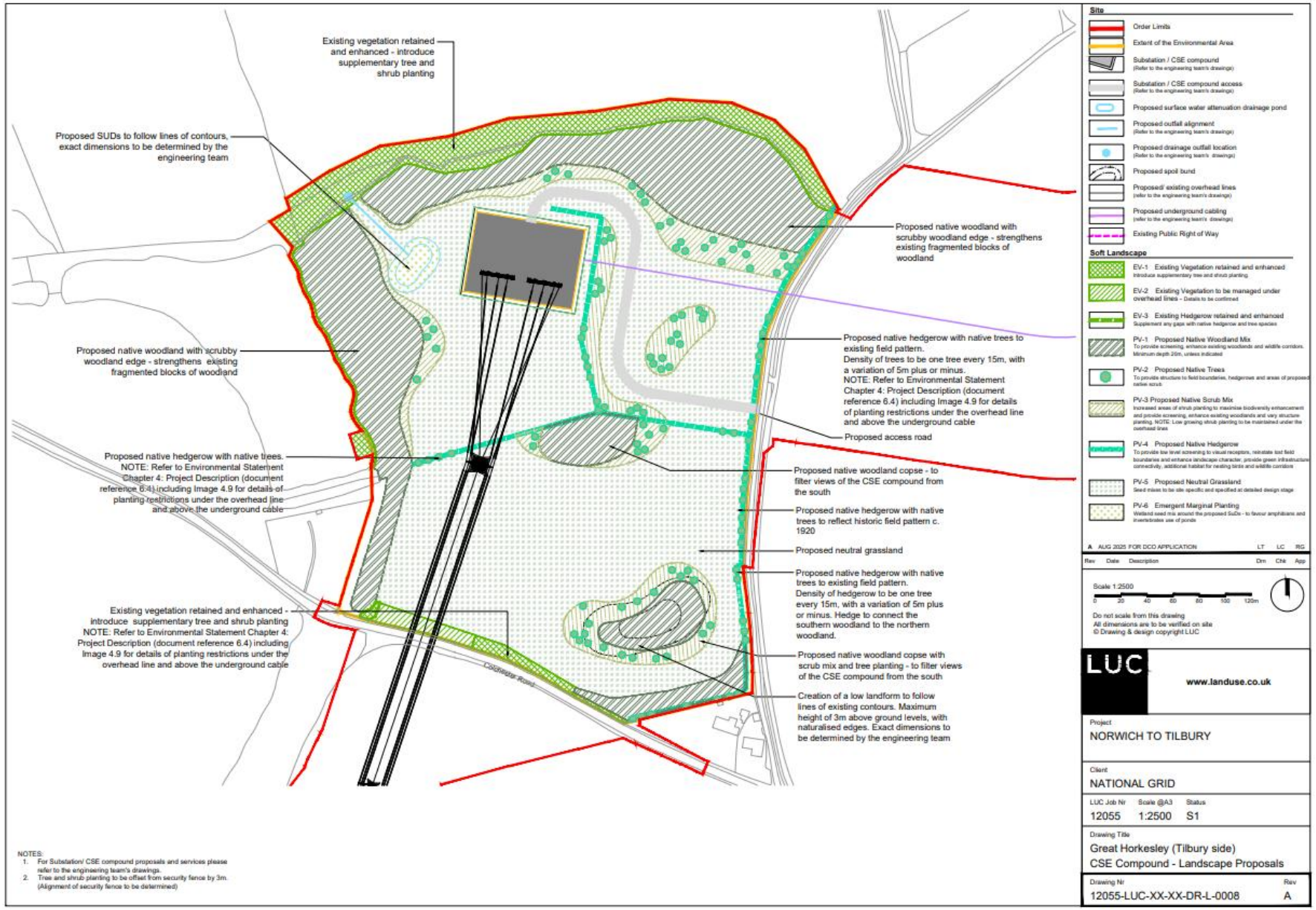


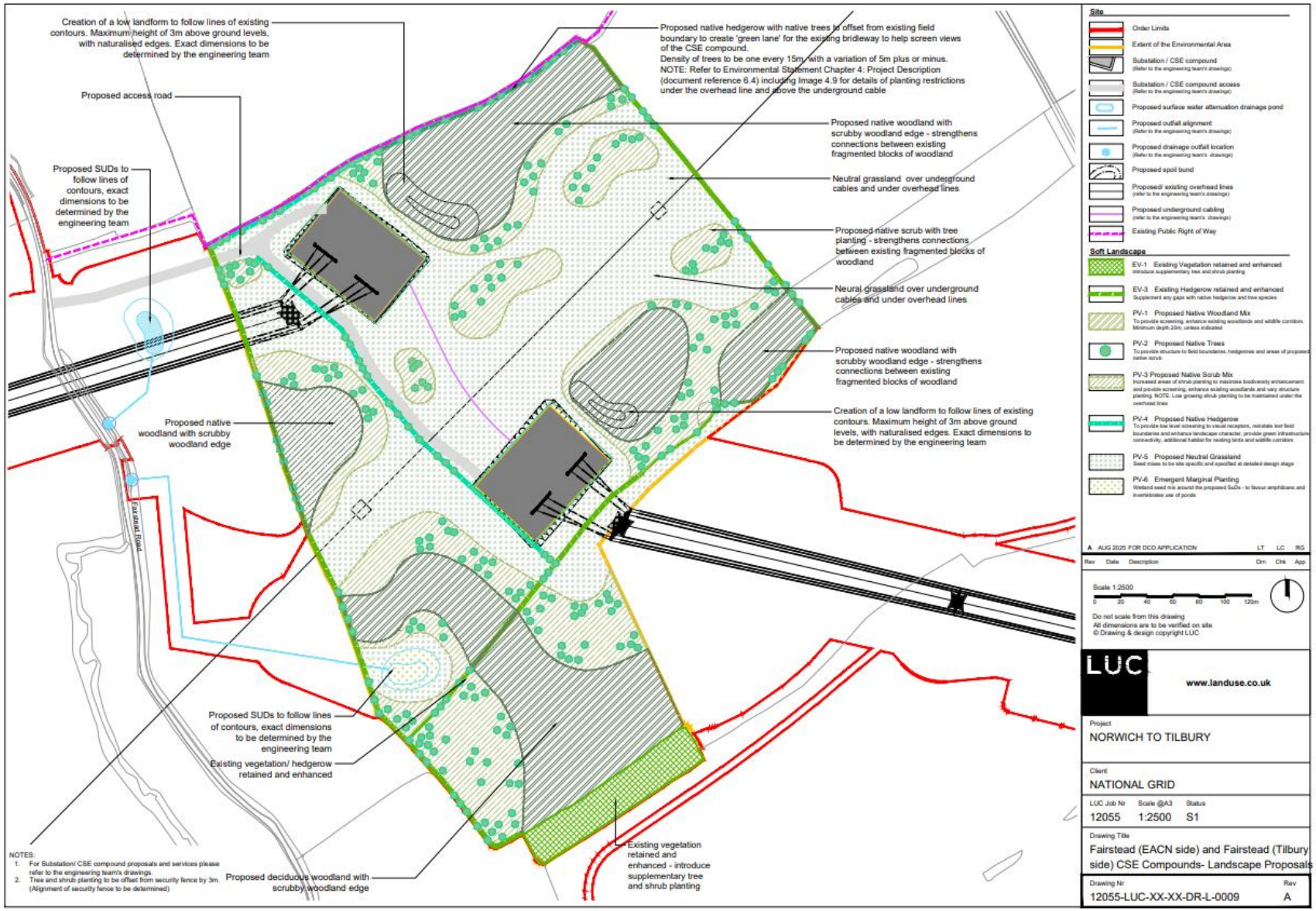
Image 1.4 Great Horkesley (Tilbury Side) Compound (Source: Appendix D of the Outline LEMP (Revision B)



Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds

1.3.19 A short section of the proposed route requires undergrounding beneath an existing 400 kV overhead line in the vicinity of Fairstead, between pylons TB115 and TB110. Drawings 18 and 19 of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed CSE compounds. The proposed Environmental Area is shown on Image 1.5 (Appendix D of the 7.4 Outline LEMP (Revision B)). Two CSE compounds are required to facilitate the transition of this short section of cable from overhead line to underground cable back to overhead line. A permanent maintenance access is proposed from the west of the compounds, off Fairstead Road. A permanent access road will link the two CSE compounds.

Image 1.5 Fairstead (EACN Side) and Fairstead (Tilbury Side) Compounds (Source: Appendix D of the Outline LEMP (Revision B))



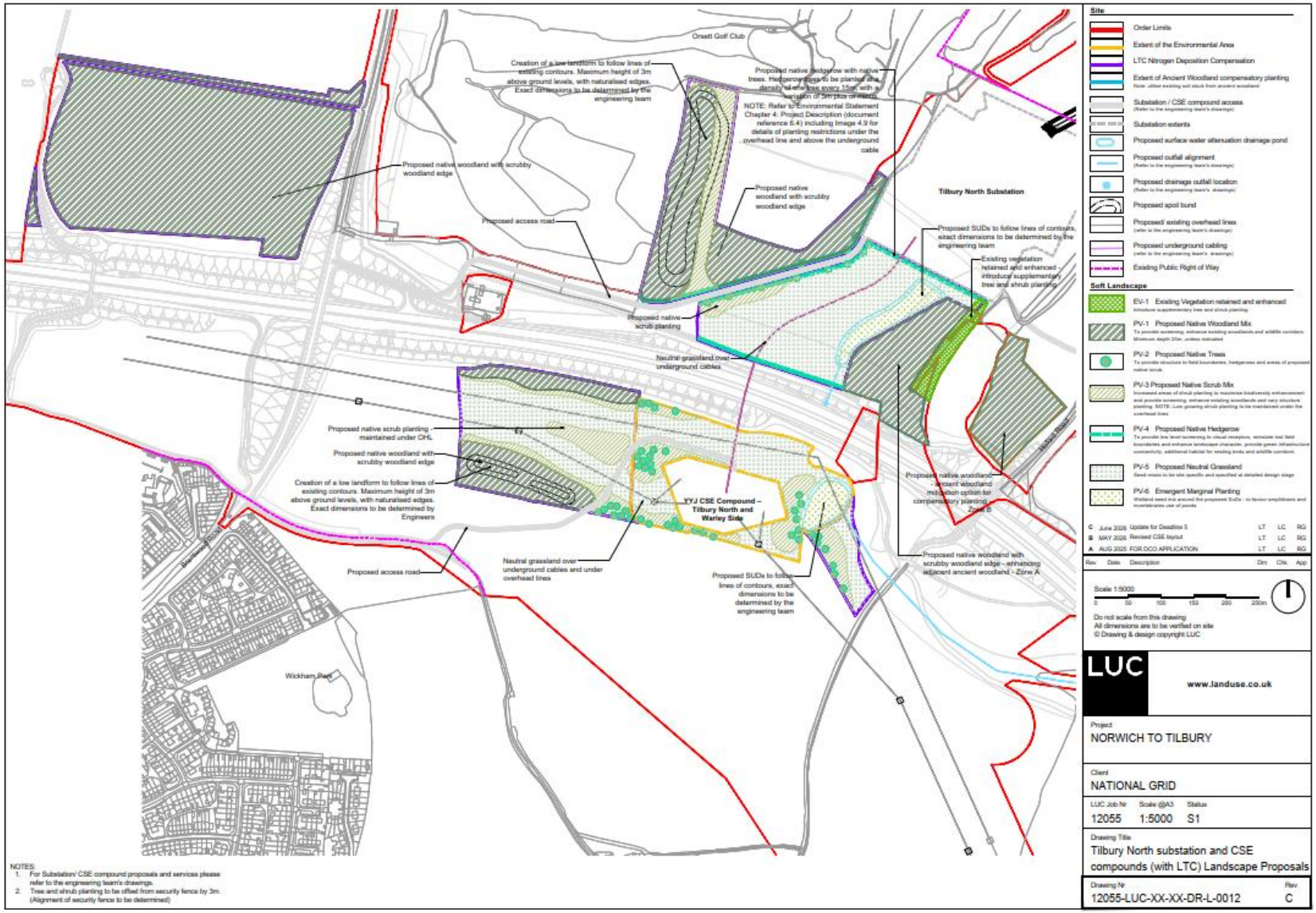
YYJ CSE Compound at Tilbury North and Warley Side (Section H)

1.3.20 To enable integration of the new Tilbury North Substation into the existing transmission network, modifications are required to parts of the local overhead line infrastructure. Drawings 16 and 17 of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed Tilbury North substation. The proposed Environmental Area included as part of the Norwich to Tilbury DCO submission is shown in Image 1.6 (Appendix D of the 7.4 Outline LEMP (Revision B)). Image 1.6 shows the Environmental Area and interaction with LTC. Lower Thames Crossing was consented after the Norwich to Tilbury DCO was submitted.

1.3.21 The DCO submission included proposals in the area south of the proposed new Tilbury North Substation, including alterations to the existing ZB route that comprised amended pylon locations, two proposed new CSE compounds (Tilbury North and Warley Side CSE Compounds) and a section of underground cable between the CSE compounds. In addition, the existing YYJ route was shown with alterations to the locations of existing pylons and new pylons to facilitate a connection into Tilbury North Substation and exiting the new substation to provide the onward connection to the existing Tilbury connection. This design is no longer being taken forward as explained in a letter submitted to the ExA on 9 February 2026 **[AS-084]** and reported in **8.11 Approach to Scenarios [REP4-310]**. The Norwich to Tilbury Project is progressing with design refinements for an alternative scenario to the south of the proposed new Tilbury North Substation (as described in paragraph 1.3.22 below).

1.3.22 Image 1.6 shows the area south of the proposed new Tilbury North Substation, with a double CSE compound arrangement and undergrounding of the YYJ route into the proposed new Tilbury North Substation.

Image 1.6 Tilbury North (YYJ) CSE Compound (Tilbury North and Warley Side) and Tilbury North Substation with Lower Thames Crossing mitigation (Source: Appendix D of the Outline LEMP (Revision B))



EACN Substation

1.3.23 The EACN Substation is a new 400 kV substation that will be built on the Tendring Peninsula near Ardleigh between the existing Bramford Substation and the proposed Tilbury North Substation. The site is adjacent to the existing UK Power Networks Lawford 132 kV substation. Drawings 14 and 15 of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed substation. The proposed Environmental Area is shown in 7 (Appendix D of the 7.4 Outline LEMP (Revision B)). The EACN Substation comprises AIS equipment.

1.3.24 The EACN Substation facilitates the contracted Essex Coast Generation Group including Tarchon Energy Limited Interconnector, and North Falls and Five Estuaries offshore wind generation projects by providing a point of connection to the National Grid. The customers have connection agreements that National Grid are required to comply with. These projects are anticipated to make landfall within East Anglia and connect via the eastern side of the substation within their allocated connection bays.

1.3.25 The substation would have an operational footprint of approximately 550 m x 230 m, excluding any requirement for landscaping and cable/overhead line connections. It is assumed that both the substation equipment and gantries would be up to a maximum height of 15 m above the finished ground level and an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the **2.3 Works Plans [REP4-015]**.

1.3.26 The connection from Bramford Substation to the EACN Substation would enter the EACN Substation via double circuit 400 kV underground cables and would exit the EACN Substation towards the Tilbury North Substation via 400 kV double circuit overhead lines.

1.3.27 The substation will be constructed to National Grid's design standards and will include a number of shunt reactors, AIS equipment, a new central control building, a PRR and other necessary equipment. In addition, several small buildings would be constructed to house electrical equipment, battery storage and workshops, together with suitably sized office/amenity buildings. There is also an area around the EACN proposed for an Environmental Area which will include landscaping and BNG.

Fencing

1.3.28 National Grid technical specification states external substation perimeter fencing must be a minimum of Category 2 fence system. Category 2 includes a fence with an overall height of up to 4 m from base level designed to BS 1722-12:2016 with an electrical pulse fence system installed to the rear (internal) face of the security fence.

1.3.29 The vehicle gates to the substation compound should match the heights and specification of the boundary treatments.

Access

1.3.30 A permanent access road between Bentley Road and Ardleigh Road across agricultural land would be constructed to provide access for Abnormal Indivisible Loads required to deliver electrical equipment and to support ongoing operations and maintenance throughout the asset lifetime.

1.3.31 The substation design will include a dedicated car parking area to accommodate staff, visitors, and maintenance personnel. The parking design ensures safe and convenient access to the control building and other key facilities. In line with modern sustainability practices, the parking area will also be equipped with Electric Vehicle (EV) charging points to support the use of low-emission transport by employees and visitors. The substation would be unmanned on a permanent basis with regular maintenance visits to the substation.

Lighting

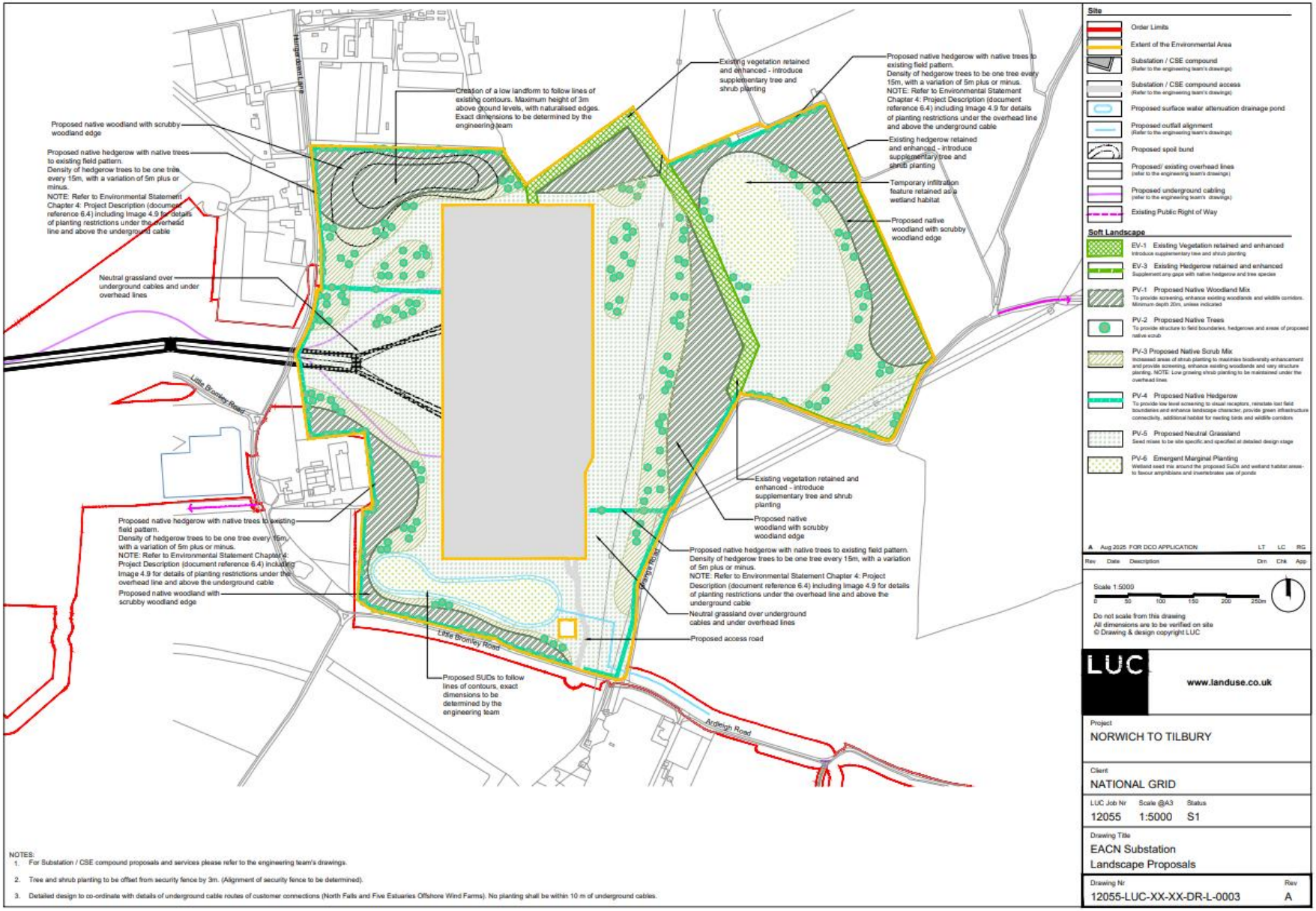
1.3.32 Exterior and interior lighting[4] would be provided at the site to allow for safe movement and the operation (and maintenance) of equipment. Lighting columns would typically be 12.5 m tall. All lighting would be designed in accordance with the appropriate design standards. The position of lighting columns would be subject to detailed design and would be determined by safety and operational requirements. Lighting would be directional and is intended to support safe movement of pedestrians and vehicles around the site (and minimise light spill to the local environment). The lighting would therefore not be on by default, and only whilst there are activities happening at the site as dictated by operational requirements. Additional task lighting may be required when undertaking specific maintenance activities.

1.3.33 Light spillage will be managed by minimising the provision of lighting: keeping to where it is required for tasks, specifying fittings that avoid light spillage, and using controls such that it only comes on when required. This will follow the dark skies strategy: to cut light pollution, its impact on wildlife, prevent wasting electricity, and mitigating visual impact at night. Windows will be fitted with blinds to control light spill if the facility is occupied after dark.

1.3.34 Indicative lux plot plans for the EACN Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 19m outside the boundary fenceline.

[4] The maximum illuminance would be approximately 20 lux within the fence line with an approximate maximum illuminance of 10 lux around the perimeter fence line. The minimum average illuminance would be approximately 6 lux, using LED lighting.

Image 1.7 EACN Substation (Source: Appendix D of the Outline LEMP (Revision B)



Tilbury North Substation and Modifications to Overhead Lines

1.3.35 A new 400 kV substation, referred to as the Tilbury North Substation, will be constructed and connected to the existing Tilbury Substation via a modification to the existing 400 kV YYJ overhead line. The proposal for this involves a double CSE compound configuration and the undergrounding of the YYJ route into and out of the proposed new Tilbury North Substation under the ZB line that would be retained as an overhead line. The final configuration of CSE compounds and undergrounding is controlled by Requirement 14. This is sited adjacent to Orsett Golf Course and Rainbow Wood Ancient Woodland.

1.3.36 The connection solution has been developed in response to technical and stakeholder feedback received during the statutory consultation process, and forms part of the Project. Drawings 20 and 21 of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed substation. The proposed Environmental Area is shown in Image 1.6 (Appendix D of the 7.4 Outline LEMP (Revision B)).

1.3.37 The decision to construct Tilbury North Substation, as opposed to installing underground cables directly into the existing Tilbury Substation (at the 2024 Statutory Consultation), follows extensive review of technical, environmental, and economic factors. The previously proposed 4.5 km underground cable route running south of Orsett Golf Course to Tilbury Substation was found to present a number of challenges, including potential conflicts with land within the designated Thames Freeport development zone, uncertainty over future land use, the likely requirement to restrict future development over the cable corridor, and associated impacts on economic growth. The site was also extremely congested from other services that connected into Tilbury Substation and presented several challenges with finding a suitable route on the approach into the substation, refer to the **5.15 DDR [APP-122]** for more information.

1.3.38 To avoid these constraints and address consultation feedback, the proposed design eliminates the need for the underground cable section and associated restrictions within the Freeport zone. It also avoids the significantly increased cost, complexity, and land use impacts of constructing a tunnelled connection. The new substation connection via the YYJ overhead line provides the same system reinforcement benefits as a direct connection into the existing Tilbury Substation, with additional system performance benefits under certain demand conditions. Feedback was sought on the siting of Tilbury North Substation with the proposed site being preferred for the reasons set out in the **5.15 DDR [APP-122]**.

1.3.39 The Tilbury North Substation will be located 5 km to the north of existing Tilbury Substation close to Orsett. The operational footprint of the new GIS Tilbury North Substation is proposed to be approximately 340 m x 530 m. The substations have 15 m maximum height and an upward vertical LoD of 10%, excluding any requirement for landscaping and cable/overhead line connections. The vertical limits (in relation to height) are defined in Article 5 of the DCO and for the Tilbury North Substation presented in Parameter Tables within the **2.3 Works Plans [REP4-016]**.

1.3.40 It will be constructed to National Grid's design standards and will include a number of shunt reactors, GIS, GIS building, annex building and other necessary equipment. The substation will connect into the existing YYJ 400 kV circuit via overhead lines or cables from the south and to the new EACN Substation via overhead lines from the

north. There are different forms that this could take with overhead line or cable configurations for the turn in and out of the new Tilbury North Substation with variable positioning of necessary CSE compounds.

1.3.41 The substation would be unmanned on a permanent basis but with regular maintenance visits. Exterior and interior lighting would be the same as the proposed new EACN Substation. Indicative lux plot plans for the Tilbury North Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 16m outside the boundary fenceline.

Fencing

1.3.42 National Grid technical specification states external substation perimeter fencing must be a minimum of Category 2 fence system. Category 2 includes a fence with an overall height of up to 4 m from base level designed to BS 1722-12:2016 with an electrical pulse fence system installed to the rear (internal) face of the security fence.

1.3.43 The vehicle gates to the substation compound should match the heights and specification as the boundary treatments.

Access

1.3.44 There are two proposed access options into the new Tilbury North Substation during operation (and maintenance), each of the two access options have two alternatives due to the interaction with third parties. The chosen option will provide both construction and access maintenance. The access options comprise:

- A Primary Access Route (PAR) via Stanford Road (east of the Orsett Cock junction), Buckingham Hill Road and Hoford Road leading to a new access road with two alternative alignments through the aggregate yard so that an appropriate route can be agreed with Clearserve. The alternative routes are:
  - Alignment running mainly along or alongside Hoford Road before crossing the south-western part of the Clearserve site, or
  - Alignment running mainly through the Clearserve site from north-east to south-west.
- A PAR via Brentwood Road leading to a new access road with two alternative alignments which comprise a temporary access road to the west of Brentwood Road, crossing Brentwood Road and then running east to west between Brook Farm and Orsett Golf Club. On completion of the LTC Brentwood Road Bridge embankment works and new junction arrangements with High House Lane, access to the substation would be via Brentwood Road and the new junction with High House Lane and then east between Brook Farm and Orsett Golf Club.

1.3.45 Details of the final arrangements in relation to access to the highway will need to be submitted to and approved by the relevant highway authority in accordance with Schedule 15 (Protective Provisions - Local Highway Authorities).

1.3.46 In addition, several small buildings would be constructed to house electrical equipment, battery storage and workshops, together with suitably sized office/amenity buildings.

1.3.47 The substation design will include a dedicated car parking area to accommodate staff, visitors, and maintenance personnel. The parking design ensures safe and convenient access to the control building and other key facilities. In line with modern

sustainability practices, the parking area will also be equipped with EV charging points to support the use of low-emission transport by employees and visitors.

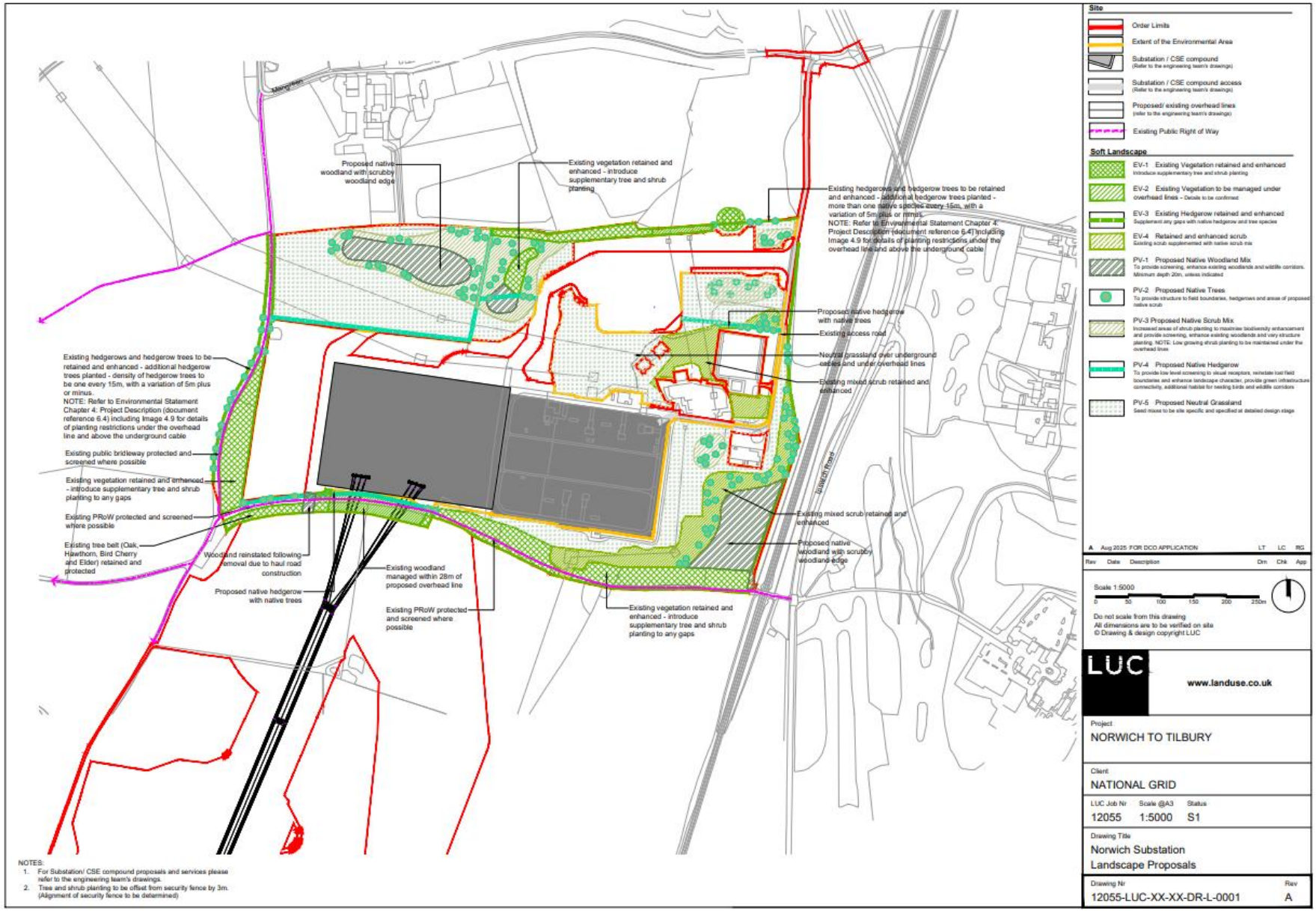
Connection Works at Norwich Main Substation

1.3.48 The Project starts at the existing Norwich Main Substation. Modification works are required to connect into the substation. **Figure 4.1: Proposed Project Design [REP4-109]** and **Figure 6.4.2: Proposed Project Design – Permanent Features [REP4-110]**) show an overhead line alignment exiting the Norwich Main Substation between pylons RG1 and RG7, which are also shown in Image 1.8. The connection works required at Norwich Main Substation would comprise:

- Two new 400 kV FLT gantries (up to 15 m in height) within Norwich Main Substation
- Installation of new, and modifications to existing, apparatus within the footprint of Norwich Main Substation.

1.3.49 A battery storage development is proposed immediately to the south of Norwich Main Substation. The Project alignment was repositioned to the West of Sprow's Pits Woodland with the introduction of an additional pylon to accommodate the battery storage development. The LoD and Order Limits in this location have been widened to the east to allow flexibility to change the alignment should planning consent not be granted for a battery storage facility to the south of the substation.

Image 1.8 Connection works at Norwich Main (Source: Appendix D of the Outline LEMP (Revision B))



Extension to Bramford Substation

1.3.50 This comprises an extension of the existing site compound with use of the existing site access arrangements. The works at the existing 400 kV Bramford Substation consist of overhead line gantries at the north (entry) and south (exit) of the existing site extension where the new double circuit overhead line enters the operational compound, between pylons RG120 and JC1. The extension would be approximately 5550 m^2 in total. This will connect to bays of AIS and then transition through Gas to Air Bushings (from one technology to another) onto runs of Gas Insulated Busbar (GIB). These busbars traverse the site around other existing infrastructure from north to south. The circuits have been designed to incorporate shunt reactors into the network which will be located in the middle of the existing high voltage compound. The equipment required for this will be non sulphur hexafluoride (SF6). SF6 is a synthetic gap that insulates and switches electrical current in switchgear, but it has a high global warming potential. The GIS will be built within the building extensions with only GIB connections visible from outside the building. In addition to the high voltage equipment there will be the inclusion of some amenity buildings to house the additional ancillary equipment associated with the new plant and equipment.

1.3.51 The equipment will be up to a maximum height of 15 m and the proposal would be approximately 300 m x 600 m for the extension works needed at Bramford Substation (including the footprint of the existing substation).

1.3.52 Drawings 11 and 12 (sheets 1 and 2 of 2) of the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C) show the indicative layout of the proposed substation extension.

1.3.53 The extension to Bramford Substation is not an area identified for mitigation planting over and above reinstatement planting due to the physical limitations around this existing substation after existing development and other planned development. Therefore there is no Environmental Area proposed.

1.3.54 Exterior and interior lighting would allow for safe movement and the operation (and maintenance) of equipment. Lighting would be designed in accordance with the appropriate design standards. Additional task lighting may be required when undertaking specific maintenance activities. Indicative lux plot plans for the extension to Bramford Substation have been provided in Appendix B. The plan provided shows that the 1 lux light spill is a maximum of 24m outside the boundary fenceline.

Drainage

1.3.55 Surface water runoff from all the Permanent Features would be managed using Sustainable Drainage Systems (SuDS) techniques appropriate to local conditions, to meet with the relevant Local Lead Flood Authority discharge requirements. Further detail can be found in the Environmental Statement (ES) Chapter 12 (reference 6.12) and within the **7.9 Flood Risk Assessment [APP-331]**.

1.3.56 Measures to mitigate any impacts from construction are included within the **7.2 Outline Code of Construction Impact (CoCP) [REP4-164]**.

1.4 Design Context

1.4.1 National Grid has published a suite of documents which detail how the design has been developed (based on environmental and engineering assessments, and a wide range of stakeholder feedback) in addition to showing the method used to evaluate National Grid's strategic choices, backcheck and review of these methods and how stakeholder feedback has been considered. A number of potential design changes have been identified and have been carefully considered in the context of environmental and socio-economic constraints and opportunities, engineering feasibility and cost, and planning considerations.

1.4.2 The design development process and decisions that were made are explained in the DDRs (National Grid 2023, 2024 and 2025 (see **5.15 DDR [APP-122]**)) and **5.1 Consultation Report [APP-066]**.

1.4.3 The relationship between the DASSI, DAS and DDR in respect of 'Good Design' is set out in Appendix A. Guide to the Approach on Design that form the Project's design approach.

1.4.4 As detailed in the **DAS [REP2-020]** and **5.15 DDR [APP-122]** the development of the Project design is based on the following national context and National Grid's design principles which include the Holford Rules and Horlock Rules to ensure 'good design' throughout the iterative design process. Refer to the **DAS [REP2-020]** for detailed policy analysis.

1.4.5 Paragraph 2.9.16 of EN-5 states that the Holford Rules *'should be embodied in the applicants' proposals for new overhead lines'*. The Holford Rules were first set out in 1959, and subsequently reviewed by National Grid in 1992. They have become accepted within the electricity transmission industry as the basis for defining overhead transmission line routeing. National Grid employs the Holford Rules to inform the design and routeing of all new overhead line projects, including the Project. Paragraph 2.9.18 of EN-5 states that the Horlock Rules *'guidelines for the design and siting of substations…should be embodied in the applicants' proposals for the infrastructure associated with new overhead lines'*. The Horlock Rules were established in 2009 by National Grid in pursuance of its duties under Schedule 9 of the Electricity Act.

1.4.6 National Grid devised the Horlock Rules (National Grid, 2009) in 2003 and updated them in 2009 in pursuance of the duties under Schedule 9 of the Electricity Act 1989. The Horlock Rules provide guidelines for the siting and design of new substations, or substation extensions, to avoid or reduce the environmental effects of such developments. They also concern the siting of CSE compounds. They facilitate the consideration of environmental factors and amenity within the design and siting of new substations and CSE compound infrastructure. Some of the key guidelines have been summarised below:

- In the development of system options including new substations, consideration must be given to environmental issues from the earliest stage to balance the technical benefits and capital cost requirements against the consequential environmental effects, in order to avoid as far as possible adverse effects
- Siting of substations, CSE Compounds and line entries should seek to avoid areas of the highest amenity, cultural or scientific value by the overall planning of the system connections

- Areas of local amenity value, important existing habitats and landscape features should be protected as far as reasonably practicable
- Siting of substations, extensions and associated proposals should take advantage of the screening provided by landform and existing features and the potential use of site layout and levels
- Proposals should keep visual, noise and other environmental effects to a reasonably practical minimum
- Land use effects of the proposal should be considered when planning the siting of substations or extensions
- In the design of new substations or line entries, early consideration should be given to the options available for terminal pylons, equipment, buildings and ancillary development appropriate to individual locations
- Space should be used effectively to limit the area required for development consistent with appropriate mitigation measures and to minimise the adverse effects on existing land use and rights of way, while also having regard to future extension of the substation
- Design of access roads, perimeter fencing, earth shaping, planting and ancillary development should form an integral part of the site layout and design to fit in with the surroundings
- In open landscape especially, high voltage line entries should be kept, as far as possible, visually separate from low voltage lines and other overhead lines so as to avoid a confusing appearance
- The inter-relationship between pylons and substation structures and background and foreground features should be studied to reduce the prominence of structures from main viewpoints. Where practicable, the exposure of terminal pylons on prominent ridges should be minimised by siting pylons against a background of trees rather than open skylines.

EACN Substation

1.4.7 The evolution of the selection of the site of the EACN was described in the Preliminary Routeing and Siting Study Report (2022) and balances factors relating to substation aspects (Horlock Rules) with factors relating to the electrical connections to them (for overhead lines this is the Holford Rules) as well as planning policy and National Grids various duties. This was developed and considered further in the DDRS (National Grid 2023, 2024 and 2025). In summary terms, a more inland location was favoured because of the effects that would have arisen from the two overhead lines down the Tendring peninsula that would have been most likely to make the necessary two points of connection (as the area is not a nationally designated landscape the use of underground cable is not likely).

1.4.8 The specific siting of the EACN within the preferred area was then informed by consideration of the Horlock Rules and in particular the selection of a site benefitting from the presence of some existing screening vegetation. In response to feedback we have also considered locations further inland including to the west of the A12. As already described, decision making is informed by changes in the 400 kV connection as well as changes required to the customer connections to reach a balanced decision. Various constraints to routeing, as explained in subsequent paragraphs of

the 2025 DDR (document reference 5.1), require additional corridors through the National Landscape to be used to extend to a more inland location. Whilst this reduces some effects to some receptors, on balance we do not consider these justify the additional effects on the National Landscape nor restrictions on future system flexibility. For further details refer to the 2025 DDR (document reference 5.1).

Tilbury North Substation

1.4.9 The evolution of the site selection for Tilbury North Substation was described in the DDR Addendum for Proposed Changes at Tilbury Connection. The Horlock Rules requires consideration to be given to the land use effects of the proposal when planning the siting of substations or extensions. In March 2023 the Thames Freeport received final government approval including up to £25 million seed funding from the government and potentially hundreds of millions in locally retained business rates to drive growth in the UK's advanced manufacturing, biomanufacturing, logistics, and low carbon industries. Whilst National Grid had originally considered that opportunities for co-existence with the Freeport, it became apparent following the formal feedback received on the 2024 statutory consultation, that the land use restrictions and technical challenges presented at the Freeport site, an alternative means of connecting into Tilbury would be preferred. A site selection and comparative appraisal was undertaken for alternative sites, informed by technical, environmental, socio-economic, programme and cost factors and evaluated in the context of guidance from the Holford and Horlock Rules. This resulted is the chosen option for Tilbury North Substation as detailed in the 2025 **5.15 DDR [APP-122]**.

AIS and GIS design

1.4.10 Both AIS and GIS substations contain the same compartments and components as each other; the main difference lies with the means of insulation. An AIS system (such as is proposed at the EACN Substation) is the normal starting position (on the basis of lower cost and relatively greater flexibility for future expansion of sites) and largely uses air as an insulator between electrical conductors and earth. GIS substations (such as is proposed at Tilbury North) are self-contained systems that largely use a gas with much better insulating properties than air as an insulator. This is particularly beneficial in locations where risk of contamination and its effects on maintenance are better managed with GIS solutions. The use of GIS solutions also allows the high voltage equipment to be much closer together, as it is not reliant on just air for insulation, enabling the substation to have a much smaller footprint than an AIS solution, which may be beneficial where land use pressures and land costs are high.

1.4.11 Key design features of GIS substations are the compact design, higher reliability, greater resilience and minimal maintenance. AIS substations provide a lower cost option with more flexibility to future and additional system requirements; the design however has a much greater land requirement. There are benefits and disbenefits of both technology solutions, for example although GIS substations have a smaller footprint, they are not always the most appropriate design solution in the context of individual landscapes. GIS substations are in large industrial looking buildings that may be more difficult to screen within the landscape. The design merits for each option have been assessed and taken into account in the design process for the EACN and Tilbury North Substations. Further details are provided in the **5.15 DDR [APP-122]** and Chapter 5 below.

Limits of Deviation

1.4.12 The Order Limits include LoDs which represent the maximum deviation for permanent infrastructure, such as the CSE compounds, and new substations and substation extensions. This allows for adjustment to the final positioning of Project features to avoid localised constraints or unknown or unforeseeable issues that may arise.

1.4.13 As recognised in guidance provided by the Planning Inspectorate (Advice Note Nine using the Rochdale Envelope), a necessary and proportionate degree of flexibility often needs to be incorporated into the design of proposed development so that unforeseen issues that are encountered after a development has been consented can be dealt with. For example, previously unidentified poor ground conditions may require development to be re-sited for geotechnical reasons.

1.4.14 Therefore, to allow for this, new infrastructure would be constructed within specified LoDs which identify a maximum distance or measurement of variation within which the works must be constructed. These comprise lateral and longitudinal LoD (i.e., on the ground) as shown on the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]**. and vertical limits (in relation to height) as defined in Article 5 of the DCO and presented in Parameter Tables within the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]**. The location and orientation of the permanent infrastructure of this Project could be located anywhere within the LoDs, as defined on the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]** (unless a commitment has been made to restrict the LoDs, – details of which are outlined within the **7.2 Outline Code of Construction Practice (CoCP) [REP4-164]**).

1.4.15 The location and orientation of the CSE compounds, new EACN Substation and new Tilbury North Substation may change within the LoDs.

1.4.16 The proposed LoDs for the Project are shown on the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]. Figure 4.1: Proposed Project Design [REP4-109] and Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**, and are required for the following non-linear works (permanent infrastructure) of relevance to this document.

CSE Compounds

1.4.17 The Order Limits include approximately 64 m x 90 m for the CSE compounds (site only), plus the LoDs either side as defined below:

- There is no definitive vertical (downwards) LoDs for the works within the CSE compounds – the depth must be no more than is necessary as per the Order. Non-linear infrastructure located within cable sealing end compounds have a 15.0 m maximum height and an upward vertical limit of deviation of 10% of that height, excluding rooftop equipment, such as but not limited to lightning protection, aerials, fall arrest systems, and handrails
- The lateral and longitudinal LoD are generally 50 m on all sides of the proposed compounds but vary locally depending on existing features (e.g. hedgerows, watercourses).

Substations

1.4.18 The Order Limits include approximately:

- EACN Substation - 640 m x 740 m (including spacing for the associated Environmental Area). The operational footprint of the new EACN Substation is proposed to be approximately 550 m x 230 m
- Tilbury North Substation- 340 m x 530 m. The operational footprint of the new Tilbury North Substation is proposed to be approximately 340 m x 300 m
- Bramford Substation extension works - 300 m x 600 m for the extension works (including the footprint of the existing substation)
- 'Environmental Areas' are shown on **Figure 4.1: Proposed Project Design [REP4-109]** and **Figure 6.4.2: Proposed Project Design – Permanent Features [REP4-110]**
- There is no definitive vertical (downwards) LoD for the works within the substations. Non-linear infrastructure located within substations have a 15.0 m maximum height and an upward vertical limit of deviation of 10% of that height, excluding rooftop equipment, such as but not limited to, lightning protection, aerials, fall arrest systems, and handrails
- The LoD for the substation works are as shown on the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]**, including space for the substations, drainage, accesses, construction compounds and soil storage.

Landscape, visual and ecological mitigation

1.4.19 Landscape and visual mitigation is proposed at Norwich Main, EACN and Tilbury North Substations and the seven CSE compounds, proposed as 'Environmental Areas'. These multi-functional areas have been prioritised, to provide mitigation or enhancements for different environmental aspects i.e. sites where landscape and visual mitigation and biodiversity gains could be achieved together. An indicative landscape design has been created for these areas as detailed within Appendix D of the 7.4 Outline Landscape and Ecological Management Plan (LEMP) (Revision B). The Outline LEMP provides the site context for each of the Permanent Features and identifies the individual landscape mitigation proposals for the Environmental Areas and shown in Image 1.2 through 8.

1.4.20 National Grid has committed to deliver at least 10% BNG with wider environmental and societal benefits The 7.4 Outline LEMP (Revision E) refers to the retention, replacement planting and onsite habitat creation and enhancement of habitats in line with the **7.1 BNG Report [APP-299]**. Where created or enhanced, habitats within these Environmental Area will be counted within the BNG assessment (onsite mitigation). The Environmental Areas are located on land to be acquired by National Grid and any habitats included within the BNG onsite mitigation, will be monitored and managed by National Grid for 30 years in line with commitments made within the **7.1. BNG Report [APP-299]**. Regular site visits will be undertaken by experienced ecologists, to ensure the habitat type and condition meet that prescribed within the BNG Report. Beyond the 30-year period it is expected that ongoing management will be undertaken by National Grid in line with standard practices around permanent assets.

1.4.21 There is flexibility for minor variations as part of the detailed design process once the engineering scheme has been fixed. It is important that any changes to the landscape proposals still align with the local landscape character. Habitat management and monitoring plans for each Environmental Area will be developed following detailed landscape design (post consent) and included within the Final LEMP, and secured through Requirement 4 (see Schedule 3 of the draft 3.1 DCO (Revision E)). The specific design objectives of the landscape and visual mitigation for the substations and the CSE compounds are set out in the 7.4 Outline LEMP (Revision E) and also in Chapter 5 of this document.

Sustainability

1.4.22 National Grid is committed to embedding a sustainable approach in the design of the Project, which is discussed in more detail in the **DAS (Final Issue B) [REP2-020]**.

1.4.23 National Grid's Environmental Action Plan for RIIO-T2 (2021-2026) (2024) focuses on four priority areas:

- ***'Net zero carbon emissions:*** *Climate change is the greatest challenge of our generation, and the next 10 years will be crucial to addressing it. We will reduce our direct emissions in line with science-based targets and deliver carbon neutral construction.'.*
- ***Minimise waste and sustainable use of materials:*** *Waste is choking our oceans, spoiling our landscapes, as well as contributing to landfill and greenhouse gas emissions. … We will achieve zero waste to landfill across key areas of waste and use circular economy principles to make the most out of natural resources and our assets.*
- ***Caring for the natural environment:*** *One of the most important challenges facing humanity, alongside the climate emergency, is the global biodiversity crisis. … We will value nature and will protect and enhance it where possible using 'natural capital' and 'net gain' principles.*
- ***Leading the way:*** *Businesses have a duty to lead the way and deliver change across industry. We will be leaders in our industry to advance environmental good practice.*

1.4.24 On this Project, this will involve reducing, where possible, material use in construction especially away from high carbon materials such as concrete and cement and reducing waste. Buildings both temporary and permanent should be energy and resource efficient. Wildlife should be preserved, with habitats enhanced where possible. The Project has committed to delivering at least 10% Biodiversity Net Gain (BNG) with wider environmental and societal benefits; further details can be found in the **7.1 Biodiversity Net Gain Report [APP-299]**.

1.5 Approach to Detailed Design and Approval Process

1.5.1 It is a statutory requirement for all Nationally Significant Infrastructure Projects (NSIPs) to demonstrate good design, and to contribute to sustainable development, mitigating and adapting to climate change. Good design of electricity transmission infrastructure is primarily governed by application of the Holford and Horlock rules, alongside an iterative design approach informed by stakeholder engagement, relevant sections of national policy (NPS EN-1 and EN-5) and the embedded

environmental design mitigation as part of the EIA process. Such good design principles are then intertwined with the technical design requirements alongside the regulatory and other constraints such as operational, safety and security requirements for new electricity transmission infrastructure.

1.5.2 The National Policy Statements for Energy (EN-1 and EN-5 (2024)) do not impose a requirement for applicants to undertake an independent design review. For electricity transmission projects, NPS EN-5 Paragraph 2.4.3 states

'…*the Secretary of State should bear in mind that electricity networks infrastructure must in the first instance be safe and secure, and that the functional design constraints of safety and security may limit an applicant's ability to influence the aesthetic appearance of that infrastructure'*.

1.5.3 This demonstrates the importance placed on the 'functionality' of design which restricts the extent of design variation.

1.5.4 To demonstrate commitment to securing Good Design, National Grid has appointed:

- Development Design Champion to provide 'internal' oversight and advocacy for ongoing good design through design development and into implementation; and
- Delivery and Detailed Design Champion to provide an Executive Board-level layer of design governance

1.5.5 The Design Champion/s will be key cornerstones to the governance and assurance for achieving Good Design.

1.5.6 In addition to the Design Champion roles, National Grid will establish a Great Grid Partnership-led Design Review Panel (DRP) for undertaking design reviews, thereby providing a level of independence to the project.

1.5.7 The Design Review Panel will be invited to review and comment on those design matters set out in the Design Principles section of the DASSI. Its role will be advisory, and it will not have the authority to determine the final design outcome alone. Design matters will be considered collaboratively and in accordance with the design panel's agreed terms of reference. Responsibility for design decisions and the selection of preferred design solutions will rest with the Design Executive, who will also provide reporting and governance oversight in relation to those decisions. The Delivery and Detailed Design Champion will oversee this process in support of securing Good Design.

1.5.8 Further details on the role of the Design Champions and Design Review Panel are set out in Section 6 of this report.

2. Site Location and Context

2.1 Baseline Landscape Context

2.1.1 The landscape context of the proposed CSE compounds, the EACN Substation and Tilbury North Substation, is set out below with reference to Section 6.6 of ES Chapter 13: Landscape and Visual (Document 6.13) the Outline LEMP (document reference 7.4).

2.1.2 Landscape character within the Project Study Area is described at the national, regional and local scales, in a series of Landscape Character Assessment publications. The following section describes the landscape character in which the fixed infrastructure is located within, which has been assessed as part of the design of the infrastructure and Environmental Areas (see Appendix D of the 7.4 Outline LEMP (Revision B)).

2.1.3 The landscape context of sites for the permanent infrastructure was taken into consideration during the siting and routeing studies. The outline landscape mitigation proposals have been developed for the areas around the CSE compounds and new substations and extensions, taking landscape context into account to create an outline design that complements the existing landscape character.

Wenham Grove CSE Compound

2.1.4 At a national level the proposed infrastructure is located in National Character Area 86: South Suffolk and North Essex Clayland. The Statements of Environmental Opportunity are published by Natural England in relation to each national character area, The statements most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include the planting of new woodlands on former woodland sites or extending and linking existing woodland using local native species. This will enhance ecological connectivity and benefit the traditional wooded appearance and character of the landscape. Other relevant opportunities are stated to include conserving, managing and replanting hedgerows and planting new hedgerow trees (notably new oak). It is noted that it is important to ensure new hedgerow planting on the plateau does not block important views and overly enclose the landscape. Planting characteristic species mixes will support biodiversity and landscape character and should include hawthorn, blackthorn, hazel, field maple, dogwood, spindle and small-leaved lime.

2.1.5 At a local level Wenham Grove CSE Compound is located within the Ancient Estate Claylands Landscape Character Type and is approximately 2 km to the north-east of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Dissected Boulder Clay plateau;
- Organic pattern of field enclosures;
- Straight boundaries where influence of privately owned estates is strongest;
- Enclosed former greens and commons; and
- Parklands.

2.1.6 Suffolk County Council Guidance Note for Ancient Estate Claylands states 'New planting should be designed to integrate the development into the character of this landscape, and may consist of both backdrop and screening planting. Although there should be a preference for native tree species other options should not be overlooked, especially if they can act as nurse trees, or are likely to prove successful in difficult conditions.'[5] The following guidelines are also relevant:

- Reinforce the historic pattern of sinuous field boundaries;
- Recognise localised areas of late enclosure hedges when restoring and planting hedgerows;
- Maintain and increase the stock of hedgerow trees;
- Maintain the extent, and improve the condition, of woodland cover with effective management; and
- Maintain and restore the stock of moats and ponds in this landscape.

2.1.7 The siting area for Wenham Grove CSE Compound is to the north of the former Royal Air Force Raydon Airfield. The ground levels are relatively flat, typically varying between 45 m and 50 m Above Ordnance Datum (AOD). The area is dominated by medium to large scale arable fields interspersed with blocks of deciduous woodland which are more frequent to the north of the area. A notable amount of woodland is found at Raydon Great Wood being approximately 700 m to the north-west. A mature deciduous tree belt runs along the former railway line to the north, connecting into Raydon Great Wood and beyond. Field boundaries vary with some being open and others defined by gappy hedgerows with few hedgerow trees.

Great Horkesley (EACN Side) CSE Compound

2.1.8 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.9 At a local level Great Horkesley (EACN Side) CSE compound is located within the Great Horkesley Farmland Plateau Landscape Character Area (LCA) and is approximately 1.3 km to the south of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Small to medium scale arable fields with concentrations of mature trees at field boundaries;
- Interesting field pattern consisting of small, regular fields to the south of Boxted and to the east of Great Horkesley;

[5] https://suffolklandscape.org.uk/landscapes/ancient-estate-claylands/

- Orchards near Great Horkesley;
- A network of narrow lanes (sometimes sunken), which are lined by trees and hedges; and
- Hedgerows are diverse and well managed/ clipped in most places.

2.1.10 Great Horkesley (EACN Side) CSE Compound is sited within an area of medium scale arable fields on a flat plateau landscape around 50 m AOD. Small blocks of woodland and trees are frequent and typically associated with settlement pattern. The boundaries of the arable field within which the CSE compound is sited vary in nature. To the south-west is a well treed field boundary and small block of deciduous woodland associated with a drain or tributary that connects into Black Brook further south. To the north-east is an overgrown hedgerow with hedgerow trees and a block of mixed woodland. Small scale fields and paddocks and scattered properties are also present adjacent to these woodlands. Arable fields lie to the north-west and south-east and boundaries between them are more open. One Public Right of Way (PRoW) (Great Horkesley FP 30) crosses the area to the south of the CSE compound and ties into another (Great Horkesley FP 29) which runs to the east of the CSE compound. The Essex Way runs along Borad Lane, immediately north of the field.

Great Horkesley (Tilbury Side) CSE Compound

2.1.11 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environment Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.12 At a local level Great Horkesley (Tilbury Side) CSE Compound is located within the Rochfords Farmland Plateau LCA and is approximately 1.3 km to the south of Dedham Vale National Landscape at its closest point. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Mixture of medium and large rolling arable fields interspersed with small woodland patches;
- Fields enclosed by gappy hedges, with occasional mature trees within field boundaries; and
- Landscape feels more open and exposed in places than the adjacent Great Horkesley farmland plateau to the west.

2.1.13 The siting area for Great Horkesley (Tilbury Side) CSE Compound falls within an area dominated by medium to large arable fields. The siting area itself lies within a sloping arable field with ground levels varying from 40m AOD in the west up to 50 m AOD in the east. A reservoir and watercourse associated with the head of a tributary valley of the River Colne is in lower lying ground to the west. The B1508 Colchester Road is to the south and is lined with robust hedgerows. Crabtree Lane is to the east. Hedgerows along Crabtree Lane are gappy, though some hedgerow trees are

present. To the north is a well vegetated drainage channel that ties into the reservoir. Tree cover is concentrated around the few scattered properties and in association with the shallow head of the River Colne tributary valley.

Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds

2.1.14 At a national level the proposed infrastructure is located in National Character Area 86: South Suffolk and North Essex Clayland. The Statements of Environment Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include the planting of new woodlands on former woodland sites or extending and linking existing woodland using local native species. This will enhance ecological connectivity and benefit the traditional wooded appearance and character of the landscape. Other relevant opportunities are stated to include conserving, managing and replanting hedgerows and planting new hedgerow trees (notably new oak). It is noted that it is important to ensure new hedgerow planting on the plateau does not block important views and overly enclose the landscape. Planting characteristic species mixes will support biodiversity and landscape character and should include hawthorn, blackthorn, hazel, field maple, dogwood, spindle and small-leaved lime.

2.1.15 At a local level Fairstead CSE compounds are located within the Central Essex Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Irregular field pattern of mainly medium size arable fields, marked by sinuous hedgerows and ditches;
- Many small woods and copses provide structure and edges in the landscape;
- Scattered settlement pattern, with frequent small hamlets, typically with greens and ponds; and
- Network of narrow, winding lanes.

2.1.16 The Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds are sited within a gently undulating landscape with medium scale arable fields. The fields are often irregular and frequently bounded by hedgerows. Many of the hedgerows are overgrown and include mature hedgerow trees. There are also small copses of trees, shelterbelts and blocks of woodland and field trees present in this landscape. The siting area itself lies within a medium scale arable field which slopes gently from around 60 m AOD in the north-east to around 55 m in the south-west. The field is bound by a combination of ditches and hedgerows with frequent trees. The east corner of the field ties into the end of a linear shelterbelt. Fairstead Road (Protected Lane) is a narrow sunken lane located one field away to the west. This lane partially follows a tributary to the River Ter to the south. Distinctive cricket bat willow (Salix alba) plantations and other vegetation are associated with the shallow valley and the tributary. An existing 400 kV overhead line runs through the field and area in a north-east to south-west orientation.

Tilbury North Substation and (YYJ CSE Compound (Tilbury North and Warley Side) (with LTC)

2.1.17 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape.

2.1.18 At a local level Tilbury North Substation and (YYJ) CSE compound (Tilbury North and Warley Side) are all located within the East and West Tilbury Open Undulating Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Undulating landform, characterised by an underlying geology of sands, silts and clays, dropping in elevation to the south and east, and with a noticeable ‘scarp’ slope to the south. Productive agricultural land (arable and pasture) with occasional small copses (hawthorn, elm, field maple and ash) as a result of the generally well drained, coarse and loamy soils over gravel
- Semi-rural and open character, as a result of regular to large sized agricultural fields bounded by gappy hedgerows and relatively few trees (much was lost post 1950, including due to Dutch Elm disease). The landscape provides a rural setting to Chadwell St Mary and Stanford-le-Hope as well as a rural backdrop to the adjacent marshes
- Remnants of a historic settlement pattern of villages linked by a network of minor roads and lanes lined by hedgerows
- Remnant Thames Terrace grasslands (semi-natural or unimproved grassland sites, now a scarce habitat but would formerly have spread along the ridge of sand and gravel from Grays eastwards through Chadwell St Mary and then upwards towards the Langdon Hills)
- Occasional areas of historic field patterns, common land, historic lanes and tracks (e.g. Hornsby Lane between Orsett Heath and Orsett) and medieval earthworks, provide time depth to the landscape
- Noticeable urban influences such as pylons, gravel extraction operations, industrial development and modern residential development (in this and adjacent character areas).

2.1.19 Within the Order Limits around the substation is a golf course and arable fields, often enclosed by hedgerows, scrubby vegetation and woodland with some mature hedgerow trees. The landscape around the CSE compound is open arable farmland. Based on an assumption that LTC is constructed, the landscape around the substation and CSE compound would change to include the road and associated earthworks, infrastructure and LTC mitigation including species rich grassland, scrub woodland and native woodland and wetland habitats. In addition, there is a proposed housing allocation at Chadwell St Mary to the south of Tilbury North substation.

EACN Substation

2.1.20 At a national level the proposed infrastructure is located in National Character Area 111: Northern Thames Basin. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character and biodiversity. These include: promoting the establishment of a coherent and resilient network of treescapes (native woodland, wood pasture, parkland, coppice, scrub, field trees and hedgerows) through expanding and linking existing woodland with areas of new planting; incorporating woodland rides and paths within woodlands to allow for public access and create a variety of habitats within the woodlands which will increase biodiversity; and maintaining the diverse appearance of the landscape and shielding developments and infrastructure from the wider landscape. Other opportunities are stated to safeguard wetlands and create new wetland habitats.

2.1.21 At a local level the new EACN Substation is located within the Bromley Heaths LCA, and the Order Limits around the EACN Substation are approximately 1.2 km to the south of Dedham Vale National Landscape. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Exposed and windswept plateau corresponding to the highest part of the district
- Deep, coarse, loamy, and often stoneless brown soils which support a high-grade agricultural land
- Large scale productive arable fields divided by low, gappy hedgerows where hedgerow oaks stand out as silhouettes against the skyline
- Apple orchards around Ardleigh, Elmstead and Frating are sheltered by belts of poplar or fast growing Leylandii
- Former heaths largely converted to smallholdings or regenerating as woodland. Small areas of remnant heath survive
- Neglected oak/sweet chestnut coppice with ground flora typical of acidic woodland soils
- Network of narrow lanes connects the scattered farms and villages, and roadside verges often contain gorse and bracken
- Dramatic, dominating skyscape.

2.1.22 Within the Order Limits around the EACN Substation there are large arable fields, enclosed by mature shelterbelts and hedgerows with some hedgerow trees. Existing overhead lines cross the Order Limits, connecting to the existing Lawford Substation to the south.

Connection Works at Norwich Main Substation

2.1.23 At a national level the proposed infrastructure is located in National Character Area 84: Mid Norfolk. The Statements of Environmental Opportunity most relevant to the Project, identify opportunities to enhance landscape character. These include the management and strengthening of the characteristic hedgerow network by protecting, managing and reinstating hedgerows and hedgerow trees and the planting of new hedgerow trees. Other opportunities are stated to include planting new areas of broadleaved woodland; minimising the effects of new development by incorporating green infrastructure and woodland buffer; and maintaining and

enhancing the floristic diversity of lowland meadow to increase the area of habitat suitable for pollinators.

2.1.24 At a local level the substation is located within the Tas Tributary Farmland LCA. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Open, gently undulating to flat and sloping landscape incised by shallow tributary valleys, the tributary streams of which are not prominent landscape features
- Large open arable fields of cereal, sugar beet and occasionally sweetcorn
- Framed open views across the countryside and into adjacent character areas
- Small blocks of deciduous woodland of high ecological and visual quality. These create wooded horizons which add variety to and create intimacy within the landscape
- Damp grasslands of ecological importance located within the tributary valleys
- Scattered remnant hedgerow trees, particularly oak, sometimes including intact avenues lining the roads or marking former, denuded, field boundaries
- Network of recreational footpaths.

2.1.25 Within the Order Limits around the substation there are large arable fields and mature belts of deciduous woodland, which provide some visual containment to the existing substation. There are existing overhead lines and underground cables which converge at the substation.

3. Examples of Existing Infrastructure

3.1 Existing Substations[6]

3.1.1 This Chapter of the DASSI document provides examples and images of existing electrical infrastructure, which whilst provided for illustrative purposes only, provides an indication of the design and appearance of similar types of infrastructure as that proposed by the Project.

3.1.2 In appearance GIS equipment is comparable to AIS as the equipment is all outdoors. The EACN Substation is proposed to be an AIS Grid Supply Point substation and Tilbury North Substation is proposed to be GIS.

3.1.3 The following images have been chosen for illustrative purposes only, they are representative of the AIS substation proposed at the EACN Substation site.

Image 3.1 Existing Norwich Main Substation 400 kV (Source: Norwich Main Site Visit)

[6] Substation sizes and/or layouts, within the Project may differ from that presented in these images.

Image 3.2 Existing Bicker Fen 400 kV Substation (Source: National Grid)

3.1.4 The following images have been chosen for illustrative purposes only, they are representative of different colours and materials of GIS substations.

Image 3.3 Existing Connah's Quay 400 kV Substation in colour cladding (Source: National Grid)

Image 3.4 Existing Connah's Quay 400 kV Substation in colour cladding (Source: National Grid)

Image 3.5 Existing Middleton 400 kV Substation (Source: National Grid)

Image 3.6 and 3.7 National Grid Deeside Centre for Innovation 400 kV Substation (Source: National Grid)

Image 3.8 Existing National Grid 400 kV Substation at Yaxley (Source: National Grid)

3.2 Existing Cable Sealing Ends

3.2.1 The following image has been chosen as it is representative of a CSE with FLT gantries[7]. The new gantry structures would generally be erected onto the prepared foundations. The conductors from the incoming overhead line circuits would be connected to the gantries via insulators and the rigid conductors on the other side, would be assembled across the new high voltage equipment.

Image 3.9 Existing CSE compound with gantries (Source: ES Chapter 4: Project Description [APP-130])

3.3 Fencing

3.3.1 National Grid propose the acceptable and fit for purpose specification of a hot-dipped galvanized steel palisade fence. This product is contained within National Grid's policy due to its durability over the required design life, as well as its availability on the market as a product which can be relied upon to perform under the anticipated loading and external conditions. National Grid is aware of no other products on the market that meet the requirements of the high security specifications, upon which HV substations are built, to the level achieved by the hot-dipped galvanized fence.

3.3.2 National Grid Policy is to specify an 85-micron thick hot dip galvanized security fence on all sites, noting this provides the most reliable and evenly distributed form of corrosion protection to meet the 50-year design life requirements for National Grid infrastructure as per the Galvanizers Association.

[7] Gantries, and compound sizes and/or layouts, within the Project may differ from that presented in these images.

3.3.3 Visibility of fencing would be further reduced following the growth of mitigation planting in the Environmental Areas. In most locations it is the steel pylons and gantries that will be the most visible structures and where fencing is fleetingly visible it will be seen in the context of these larger metal structures.

3.3.4 Whilst a powder coated finish can be applied to an already galvanized steel element to provide a colour finish, this finish cannot match the durability of the galvanized alternative. A powder coated finish would be suitable for lifespans of up to 20 years and, if exposed to prolonged periods of UV, the product could deteriorate quicker than this. Whilst a powder coated fence would still have the basic corrosion protection of the galvanized steel fence, ensuring the National Grid design life, the product would become unsightly and require re–coating to maintain its “as installed” appearance.

3.3.5 Based on a best-case scenario of 20 years to replace, this would mean reapplying the powder coated finish 3 times within the 50-year design life. The process for applying powder coating is not something that can be done on site and requires factory conditions to ensure adequacy. This would mean removing fencing whilst the National Grid HV substation is in operation, jeopardising the security and safety of the site, which is not feasible for such assets. Based on the above information, the cost, programme, and security implications of providing a powder coated finish are demonstrably greater than the standard galvanised option and it is therefore National Grid’s proposal to proceed with galvanised only fencing for all sites. Should a powder coated application be specified, the implications of programme, cost and security will demand further cost on the project that would ultimately be borne by the end user. Further implications arising from operational safety would be introduced by the need to remove and repaint an existing fence of an operational HV substation. This would not be acceptable, even if the increased costs could be accommodated, and any maintenance would likely require bespoke and complex mitigations in place to ensure security and safety throughout.

3.3.6 The following image shows security fencing that has been used at an existing National Grid substation.

Image 3.10 Existing substation - Norwich Main 400 kV (Source: National Grid)

3.4 Colours and Materials

3.4.1 The following images are for illustrative purposes only, they show the types of building and fencing finishes and colours that have been used on National Grid infrastructure.

Image 3.11 Example of finishes, colours and surfacing.

Image 3.12 Examples of colour samples for consideration

4. DCO Design and Operational Function

4.1 Cable Sealing End Compounds

4.1.1 An illustrative design of an overall size CSE compound is presented in the diagrammatic illustration in Image 4.1. The illustration explains the function of the various elements required.

Key

A. CSE (400 kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 2 x 1.5 x 8 m (LxWxH) per individual unit

B. Surge arrestor (400 kV): safeguard electrical equipment from overvoltages caused by lightning or switching events diverting the excess voltage to the ground, preventing it from damaging the equipment. Approximate dimensions: 1 x 1.5 x 6.5 m (LxWxH) per individual unit

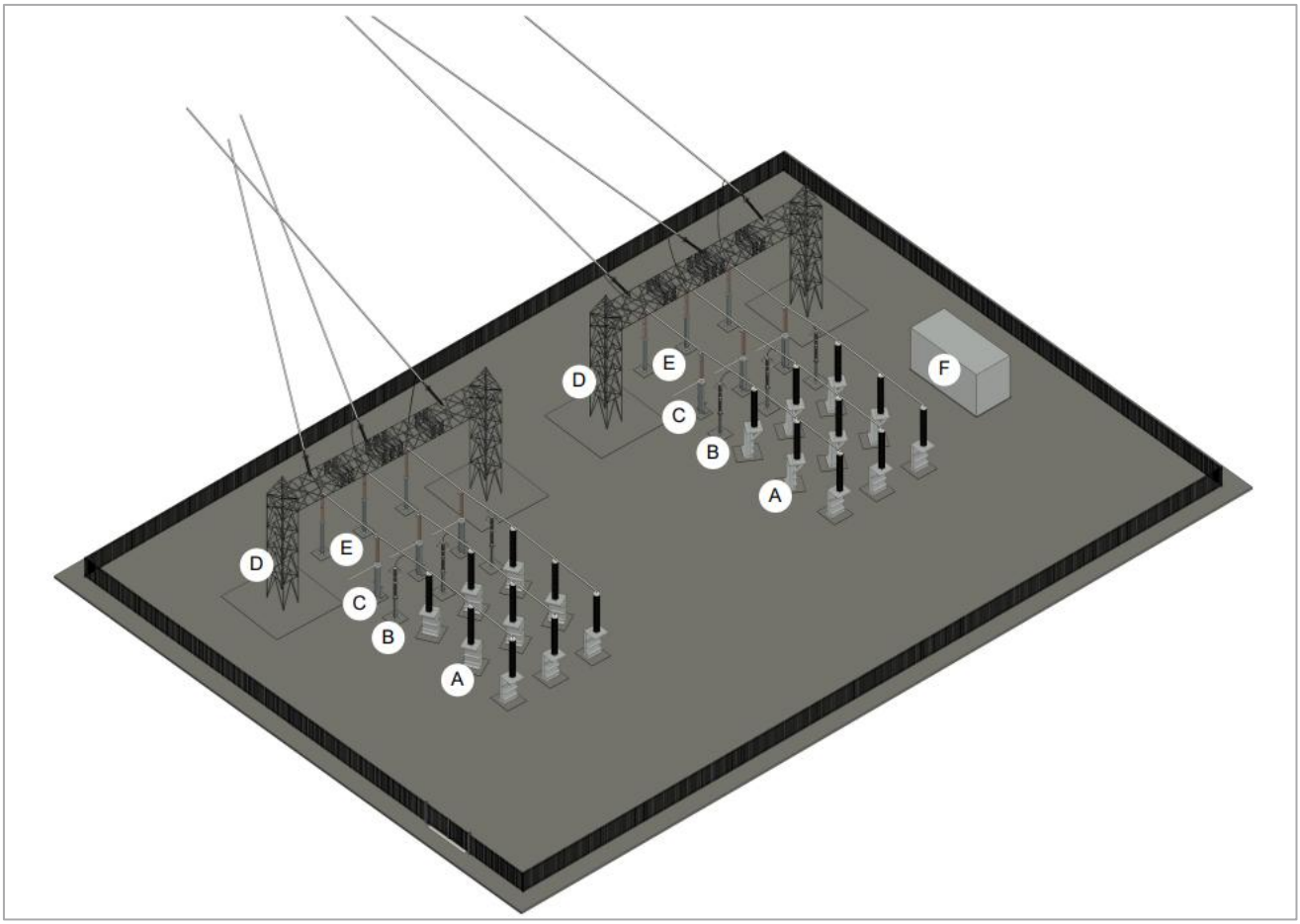
C. Earth switch (400 kV): discharge any residual voltage trapped in the circuit, ensuring the safety of personnel during maintenance or repair work. Typically installed alongside isolators in high-voltage switchgear systems. Approximate dimensions: 1 x 1 x 7.5 m (LxWxH) per individual unit

D. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon. Approximate dimensions: 26 x 2.5 x 15 m (LxWxH)

E. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 7.5 m (400 kV)

F. PRR is a fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, Supervisory Control and Data Acquisition system remote terminal unit (SCADA RTU) for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like Glass Reinforced Plastic (GRP) or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH). The PRR will be provided if required.

Image 4.1 Illustrative example of CSE compound



4.2 Substations

EACN Substation

4.2.1 An illustrative design of the EACN Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Super Grid Transformers (SGT): Step down the voltage and regulate power flow with a cooler bank attached to each side. Approximate dimensions: 15 x 25 x 11 m (LxWxH). The SGTs may be placed within acoustic enclosures to attenuate noise. The acoustic enclosures are typically constructed from modular steel frames.

B. Shunt Reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH). The Shunt Reactors may be placed within acoustic enclosures to attenuate noise. The acoustic enclosures are typically constructed from modular steel frames. Coloured paint finish for the modular steel acoustic enclosures will also be applied, typically using either RAL 6003 Olive Green or RAL 7037 Grey.

C. Overhead Line Gantry (400 kV): Transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

D. Diesel generator: Provides backup power, approximate dimensions: 9 x 5 x 5 m (LxWxH)

E. DNO building: Houses the 11 kV/415 V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 7 x 15 x 3.5m (LxWxH)

F. Post Insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain/polymeric insulators above a steel structure. The height of this equipment including the structure would be approximately 8 m (400 kV)

G. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 4 x 8 m (LxWxH) per individual unit

H. PRR: A fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, SCADA RTU for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like GRP or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH)

I. CSEs (400 kV): Interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5 x 2 x 8.5 m (LxWxH) per individual unit

J. National Grid control and amenity building: Control building houses protection equipment, control equipment, Low Voltage Alternating Current (LVAC) distribution board, battery systems, telecommunications and control/permit room. Amenity building houses rooms such as meeting room, mess room, archive, general office, shower, changing/locker room, etc. Modular construction, prefabricated steel unit which can be road transportable. Approximate control building dimensions: 35 x 15 x 5 m (LxWxH) and amenity building dimension: 25 x 15 x 5 m (LxWxH)

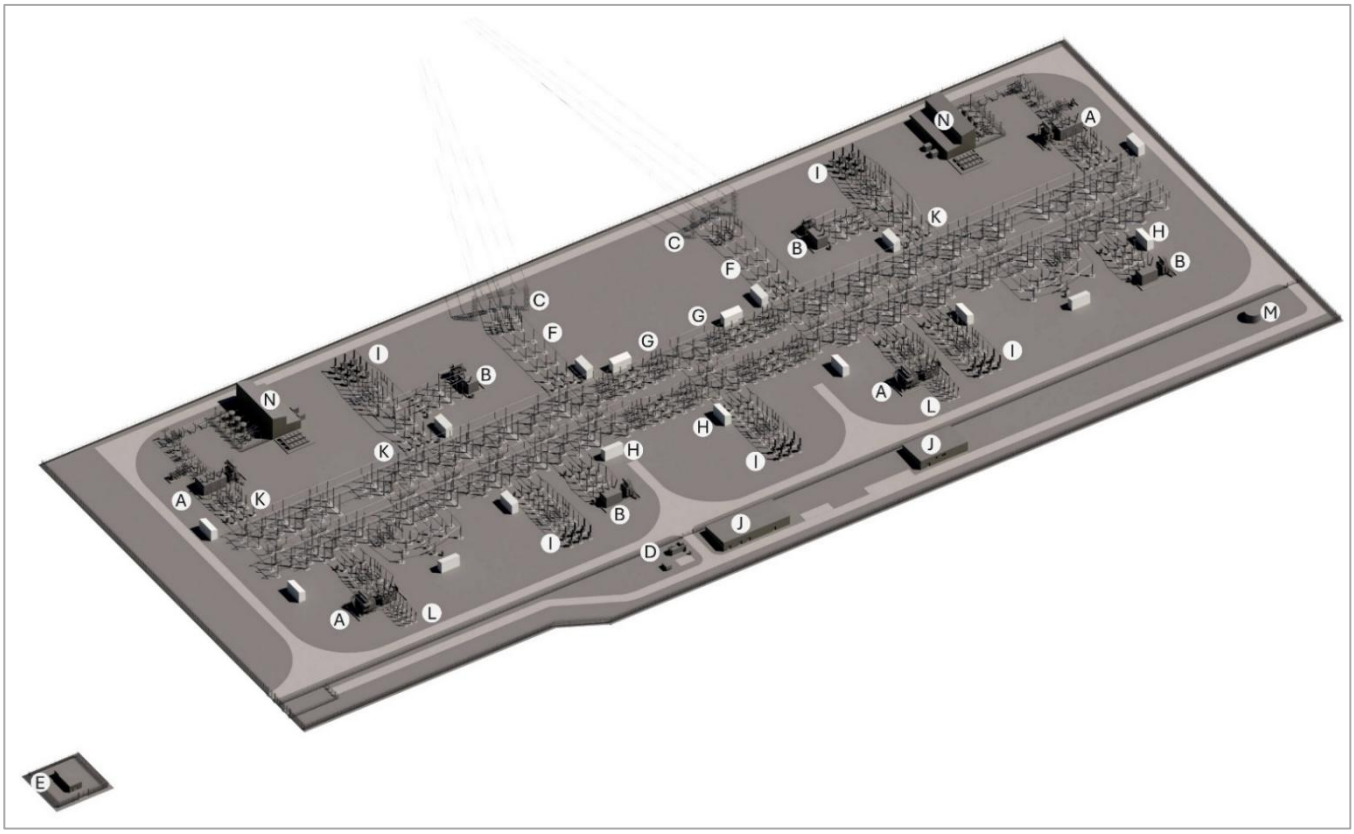
K. Circuit Breaker (400 kV): Interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5 x 1 x 7.4 m (LxWxH)

L. CSE (132 kV): Interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5 x 1.5 x 6 m (LxWxH) per individual unit

M. Water tank: Firefighting requirement to provide 120 l/s for 1 hour. Glass fused to steel construction with a galvanised steel frame. Approximate dimensions: 7 m diameter and 4 m height

N. Dynamic Reactive Compensator (DRC) building: DRC technology is crucial for enhancing the stability and reliability of high voltage substations. It is often integrated with Static Synchronous Compensator systems to provide reactive power compensation and voltage stability. Approximate building dimension: 30 x 15 x 12 m

Image 4.2 Illustrative example of EACN Substation



Tilbury North Substation

4.2.2 An illustrative design of Tilbury North Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Gas insulated busduct: Electrical busbar system where the conductor is insulated by gas within a metal enclosure

B. Shunt reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH). The Shunt Reactors may be placed within acoustic enclosures to attenuate noise. The acoustic enclosures are typically constructed from modular steel frames. Coloured paint finish for the modular steel acoustic enclosures will also be applied, typically using either RAL 6003 Olive Green or RAL 7037 Grey.

C. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

D. Diesel generator: provides backup power, approximate dimensions: 9 x 5 x 5 m (LxWxH)

E. DNO building: houses the 11 kV/415 V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 7 x 15 x 3.5 m (LxWxH)

F. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain/polymeric insulators above a steel structure. The height of this equipment including the structure would be approximately 8 m (400 kV)

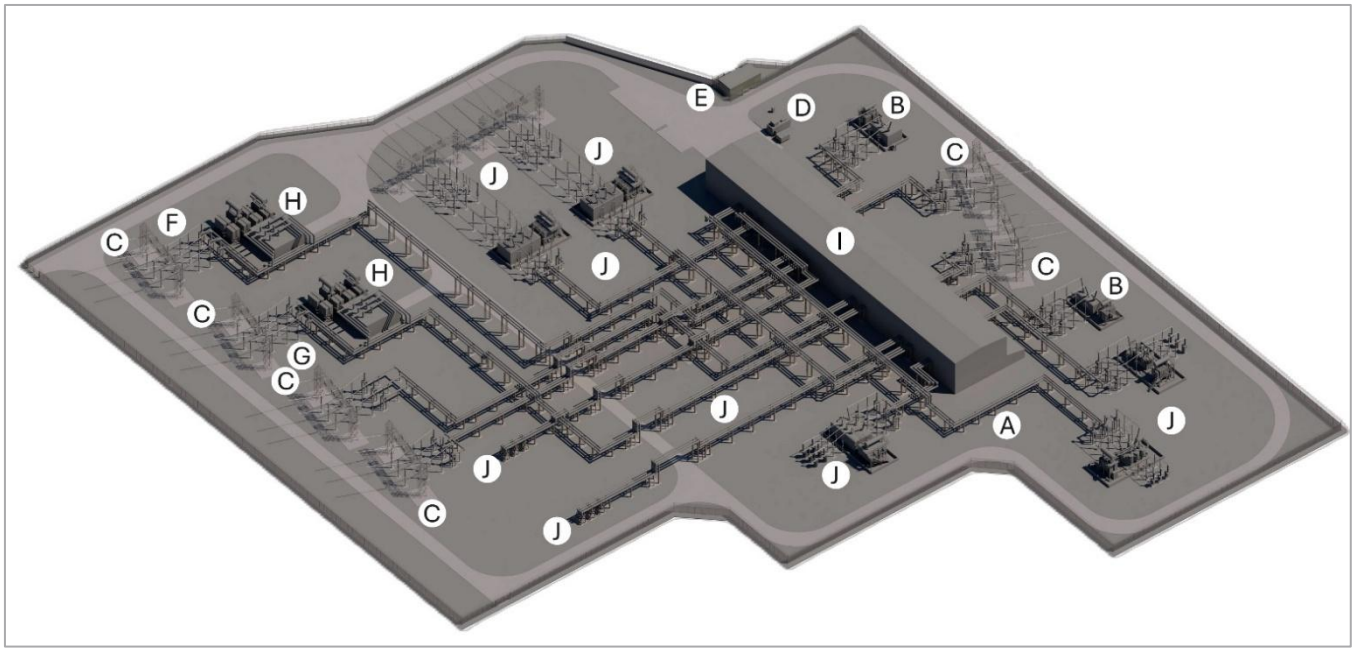
G. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 4 x 8 m (LxWxH) per individual unit

H. Quadrature booster: helps manage power flow, prevent overloads, and improve the stability and efficiency of the power grid. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 25 x 30 x 11 m (LxWxH)

I. National Grid GIS building: Houses GIS panels, protection equipment, control equipment, LVAC distribution board, battery systems, telecommunications and control/permit room. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 135 x 30 x 15 m (LxWxH).

J. Future equipment: Denotes area reserved for future equipment requirements

Image 4.3 Illustrative example of Tilbury North Substation



Extension to Bramford Substation

4.2.3 An illustrative design of the extension to Bramford Substation is presented in the diagrammatic illustration below. The illustration explains the function of the various elements required.

Key

A. Shunt Reactors: Stabilise voltage during load changes and to compensate for reactive power. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 10 x 18 x 11 m (LxWxH)

B. Overhead line gantry (400 kV): transfers high voltage conductors from an overhead line pylon to substation equipment. Approximate dimensions: 25 x 2.5 x 15 m (LxWxH)

C. Circuit breaker (400 kV): interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5 x 1 x 7.4 m (LxWxH)

D. Post insulators: Support high voltage conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8 m (400 kV)

E. Earth switch/disconnector (400 kV): The disconnector isolates a circuit, while the earth switch then grounds it to ground potential, effectively eliminating any residual voltage. This combination is crucial for preventing electrical shock and ensuring the safety of personnel working on the equipment. Approximate dimensions: 10 x 5.6 x 8.6 m (LxWxH) per individual unit

F. National Grid existing GIS building: Houses GIS panels and local control cubicle. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 155 x 17.6 x 14.5 m (LxWxH)

G. National Grid new GIS building: Houses GIS panels and local control cubicle. Modular construction, prefabricated steel unit which can be road transportable. Approximate dimensions: 32 x 17.6 x 15 m (LxWxH)

H. Gas insulated busduct: Electrical busbar system where the conductor is insulated by a gas, within a metal enclosure

I. PRR: A fully integrated portable building designed to house protection and control equipment for power systems. They typically include custom-designed protection and control equipment, SCADA RTU for remote monitoring and control, and environmental controls such as heating, lighting, power supply, and air-conditioning etc. Constructed from materials like GRP or stainless steel. Approximate dimensions: 10 x 5 x 6 m (LxWxH)

J. Lighting pole: The lighting pole is designed to provide adequate illumination for the substation area, ensuring safety and visibility during night-time operations. It is equipped with energy-efficient fixtures. The pole is strategically placed to cover key areas, including pathways, equipment zones, and control rooms

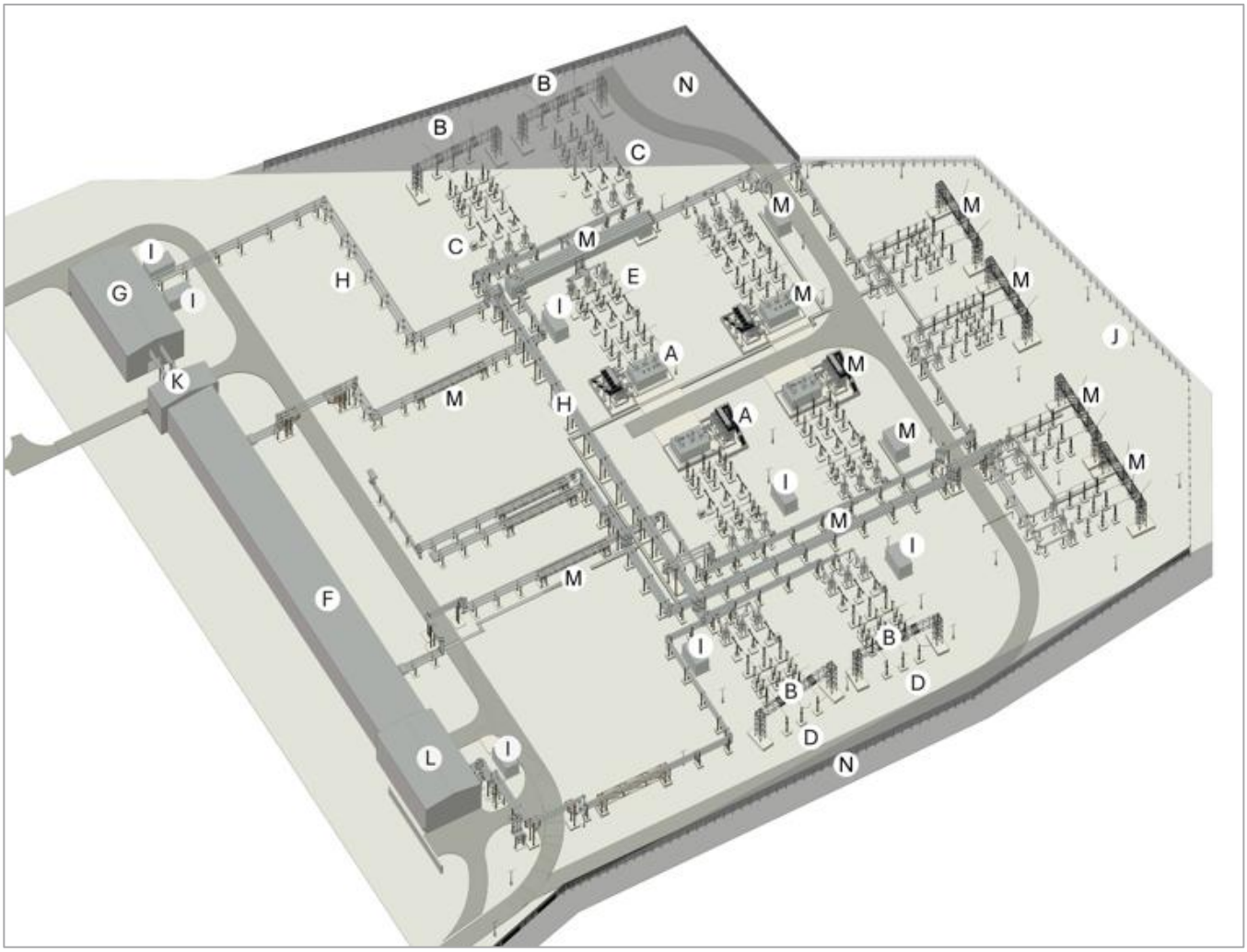
K. Southern side extension of National Grid existing GIS building: The extension will house additional GIS panels and local control cubicles. It will be constructed using modular, prefabricated steel units, designed for easy road transportation and integration with the existing building. Approximate dimensions: 7.5 x 17.6 x 15 m (LxWxH)

L. Northern side extension of National Grid existing GIS Building: The extension will house additional GIS panels and local control cubicles. It will be constructed using modular, prefabricated steel units, designed for easy road transportation and integration with the existing building. Approximate dimensions: 28 x 17.6 x 15 m (LxWxH)

M. Future equipment: Denotes area reserved for future equipment that is not needed as part of this Project but required for future connections and built on a phased basis

N. Substation Platform Extension: Denotes the area of the substation platform to be extended.

Image 4.4 Illustrative example of extension to Bramford Substation (extension shown in grey)



Link Pillars

4.2.4 National Grid is proposing to utilise 400kV underground cables in four locations. The locations and approximate length of underground cables are summarised below:

- Dedham Vale National Landscape. 16.8km of underground cable of which 5.7km is within the National Landscape Designation
- Great Horkesley. 3.9km of underground cable
- Fairstead. 0.15km of underground cable.
- North Tilbury (related to the ZB/YYJ Route). 0.6km of underground cable.

4.2.5 Depending on the cable manufacturer and availability of cable lengths, joint bays would be required every 500 m to 1 km on each cable trench. The link pillars have typical dimensions of 2 m x 0.7 m x 1.5 m plus, for example, a timber fenced area around them, typically 3 m x 4 m. Where link pillars are grouped together, two cabinets are typically located adjacent to each other (back-to-back) and the surrounding fenced area would be approximately 4 m x 4 m. This is depicted in 2.6.1 Design and Layout Plans – Subs and Cables (Revision C), drawing (AENC-MMAC-ENG-DWG-0085-06A).

4.2.6 The height of the surrounding post and rail fence would typically be similar to the agricultural fencing encountered in the same area. Where large livestock may be present, higher fencing may be specified to ensure the link pillars remain sufficiently protected. In accordance with BS 1722-7 guidance the height of a wood post fence shall typically be a maximum 1.3 m, unless otherwise required.

4.2.7 The surface treatment within the compound would typically be reinstated soil, seeded with grass, as can be seen in 2.6.1 Design and Layout Plans – Subs and Cables (Revision C), drawing AENC-MMAC-ENG-DWG-0085-06A, which provides an example image of a pair of link pillars for further context.

4.2.8 Other surfacing may be considered where appropriate, for example in scenarios where the link pillars are located adjacent to existing hard standing areas, crushed granular material may be used. Crushed granular material or paving slabs may be used immediately adjacent to the doors of the link pillar to retain a clear working space.

4.2.9 The link pillar locations are dependent on the length of the cable sections which can be influenced by the detailed cable system design, the crossing constraints along each section and the access constraints.

4.2.10 The bonding cables (between the cable joints and link pillars) have an approximate maximum length of 15m, therefore the link pillars need to be located adjacent to the cable joint.

4.2.11 Taking a reasonably worse case, an average cable section length of 800 m can be assumed, although some sections may be shorter, they would be outweighed by longer sections elsewhere along the route. Using circa. 800 m results in the following:

- Dedham Vale National Landscape, Section C in total (noting it includes land within the DVNL as well as land outside the DVNL) extends to 16.8 km: 20 joint bays and link pillars per trench. As a worst case scenario this would require 120 link pillars (for six trenches). Approximately 5.7 km of this cable route is within the National Landscape, resulting in 42 link pillars being required as a worst case within the National Landscape itself. These would be grouped into six link pillars in any given location and on average 800 m between groupings. It is not technically possible to collocate all six link pillars together therefore it is likely that there would be three groups of two spread across the easement swathe.
- Great Horkesley, Section D, 3.9 km: 5 joint bays and link pillars per trench. As a worst case scenario this would result in 30 link pillars.
- Fairstead, Section E, 0.15 km: 0 joint bays and link pillars
- North Tilbury (YYJ route), Section H, 0.6 km: 1 joint bay and link pillar per trench. As a worst case scenario this would result in six link pillars.

Image 4.5 Existing Link Pillar and post and rail fence

5. Design Principles and Scope for Variation in Developing the Detailed Design

5.1 CSE Compound Design Principles and Scope for Variation

5.1.1 This section sets out the design principles that led to the development of the CSE compound layouts and explains where there is and is not scope for variation within the design and how elements for the CSE compound will look. There are some areas where there is no scope for variation, this is due to specific equipment being required to meet technical and safety standards and therefore cannot be altered.

Electrical Equipment

5.1.2 The electrical equipment required within the CSE compounds is governed by standards and type tests which confirm a product meets strength and capability requirements.

5.1.3 There is no scope to vary the colour and finish of the electrical equipment needed. Typically, busbars and clamps are manufactured from aluminium (dull silver grey). Insulators are either porcelain (usually reddish brown or grey) or silicone (usually grey) and the manufacturers of equipment vary in their preference. Steel support structures within the compound would be left in a galvanised finish (dull silver grey) to avoid maintenance requirements in close proximity to 'live' equipment.

Size and Layout of CSE Compounds and Separation between Electrical Equipment

5.1.4 These design requirements and the dimensions of the electrical equipment and supporting infrastructure determine the overall size of the CSE compound and therefore there is very limited scope to vary the size and layout. Overarching National Policy Statement for Energy (EN-1) and the National Policy Statement for Electricity Networks Infrastructure (EN-5) recognise that there is very limited scope to alter the design and physical appearance of the linear and non-linear works, key elements such as substations and CSE compounds are fixed by their functional needs. See **DAS [REP2-020]** for more information.

5.1.5 The requirements National Grid adheres to sets out the basic separation and safe working distances that have to be maintained between equipment and between live equipment and the ground or any ancillary structures, buildings, masts, roads and fences. Live equipment is any equipment that is energised or electrically 'turned on'. The safe working distance for 400 kV equipment is 3.1 m.

5.1.6 Without adequate clearance between items of electrical equipment and vehicles requiring access into the CSE compound, more than one part of the CSE compound may need to be turned off, which may compromise the integrity of the system and supply to local users. For these reasons National Grid designs its system so that no

more than one part of the system needs to be switched off for any work to be carried out on it.

5.1.7 The overall size of the CSE compound has to provide space for the temporary accommodation of CSE testing equipment which is mounted in a lorry. Due to the technical requirements, there is no scope to vary the separation between the electrical equipment.

Arrangement of the CSE Compounds' Electrical Equipment

5.1.8 The orientation and arrangement of the overhead line entry into the CSE compounds has influenced the orientation and layout of the CSE compounds. The compounds are orientated to be perpendicular to the incoming overhead line to simplify the arrangement of electrical equipment and minimise the overall footprint. There is no scope to vary the arrangement of the electrical equipment within the CSE Compounds as it would result in a less efficient layout.

CSE Compound Boundaries (Fences, Walls and Gates)

5.1.9 Regarding the materials/finishes used for the fencing, all fencing at the CSE compounds will have a standardised galvanised finish, up to 4 m in height. The fencing cannot be painted due to future maintenance issues as discussed in detail above. There is therefore no scope to vary the material or finishes or the boundary fences, walls or gates.

5.1.10 The Environmental Areas (Appendix D of the 7.4 Outline LEMP (Revision B)) proposed around the CSE Compounds seek to reduce landscape and visual impacts through appropriate landscaping mitigation, that would help to screen the Permanent Infrastructure including the fencing.

5.1.11 The vehicle gates to the CSE compound will match the heights and specification of the boundary treatments.

CSE Compound Roads, Footpaths and Other Surfacing

5.1.12 To ensure the proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75 mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

5.1.13 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application (**Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**) include parking spaces. The number of spaces is judged on a site-by-site basis. Further detail on access is provided in the **DAS [REP2-020]**.

5.1.14 For the external access roads, they would be constructed using an impermeable surface such as asphalt or concrete respectively. The requirement for substation surfacing is that it should need little to no maintenance (for up to 40 years), be load bearing and protected from spillages (fuel/oil). Given these requirements, it precludes the use of unbound material so there is no scope for variation in the surfacing of the access roads.

5.1.15 Where the permanent accesses are impermeable SuDS will be installed to collect, treat, attenuate and discharge the runoff from the access road. SuDS best practice shall be used including the prioritisation of infiltration techniques close to the source where possible.

Finished Site Level

5.1.16 The site finish levels for the CSE compounds are shown in the 2.6.1 Design and Layout Plans - Subs and Cables (AENC-MMAC-ENG-DWG-0085) (Revision C). Non-linear infrastructure located within the CSE compounds have a 15 m maximum height and an upward vertical LoD of 10%. The site finish level for the permanent infrastructure is approximately indicated 2.6.1 Design and Layout Plans - Subs and Cables (Revision C), and secured in Schedule 19 of the dDCO as identified below:

- Wenham Grove CSE Compound
  - The site finish level is shown as approximately +47.866 m AOD on AENC-MMAC-ENG-DWG-0085-13 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).
- Great Horkesley (EACN Side) and Great Horkesley (Tilbury Side)
  - The site finish level at Great Horkesley (EACN Side) is shown as approximately +50.500 m AOD on AENC-MMAC-ENG-DWG-0085-16 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).
  - The site finish level at Great Horkesley (Tilbury Side) is shown as approximately +47.000 m AOD on the AENC-MMAC-ENG-DWG-0085-17 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).
- Fairstead (EACN Side) and Fairstead (Tilbury Side)
  - The site finish level at Fairstead (EACN Side) is shown as approximately +58.300 m AOD on AENC-MMAC-ENG-DWG-0085-18 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).
  - The site finish level at Fairstead (Tilbury Side) is shown as approximately +60.300 m AOD on AENC-MMAC-ENG-DWG-0085-19 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).
- Tilbury North (YYJ))
  - The site finish level at Tilbury North (YYJ) is shown as approximately +16.350 m AOD (Warley Side and Tilbury Side) on AENC-MMAC-ENG-DWG-0085-24 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).

Summary

5.1.17 In summary the areas where there is scope for variation at the CSE Compounds are:

- Location based on the LoD (details can be found in Section 1.4 above) and
- The landscape mitigation proposals.

5.2 Substations

5.2.1 This section sets out the design principles that led to the development of the substation layouts, and explains where there is scope for variation within the design and how elements for the substations will look. The areas where there is no scope for variation are due to specific equipment required to meet technical and safety standards and therefore cannot be altered.

Substation Compound Design Principles

General Requirements and Design Principles

5.2.2 The necessary lifespan of various components in the infrastructure of a particular site varies based on whether maintenance can be performed while high voltage equipment is in use. National Grid's assets have a minimum life span of 50 years, although they are expected to have a life span of at least 80 years. The substation buildings (until their first maintenance) typically have a 15-year design life. Any deviations from standard design or materials needs to be carefully evaluated with this factor in mind, as alternatives could result in interruptions to energy flows and undermine National Grid's ability to fulfil its obligations. This limits the extent to which deviations to the standard design are possible.

5.2.3 National Grid designs its substations according to a set of safety instructions, policies, standards and guidance notes based on international standards. A substation layout is designed to protect staff working within, the wider public, local community and environment, protect the equipment in the substation and allow safe access to install, maintain, or remove all or part of the substation.

5.2.4 In general, there is a minimum size for substations, the buildings and infrastructure are positioned to avoid clashes with utilities, to manage site topography, and to minimise visual and environmental impact. Once this is fixed there is very little variation to amend the design of the substations.

Separation Between Electrical Equipment

5.2.5 The requirements National Grid adheres to set out the basic dimensions that must be maintained between equipment and between live equipment and the ground or any ancillary structures, buildings, masts, roads and fences. Without adequate clearance between items of electrical equipment and vehicles requiring access into the substation, more than one part of the substation may need to be turned off, which may compromise the integrity of the system and supply to local users. For these reasons, National Grid designs its systems so that no more than one part of the system needs to be switched off for any work to be done on it. Generally, the distance required between equipment, and between live equipment and other structures depends on the system voltage and the size of any vehicles or working platforms required to access equipment which is not at ground level. The safe working distance for 400 kV is 3.1 m. This limits the opportunity to minimise the scale, but the proposed design is as small as possible to ensure efficiency.

5.2.6 Equipment containing oil (such as the transformers) require a bund surrounding them to contain any spillage. The equipment and their bunds then need adequate separation so that if there is a fire it does not cause damage to other critical items of

equipment. The transformers also have an acoustic enclosure surrounding them to limit noise emitted, but this does not add to the space required.

Boundaries (Fences, Walls and Gates)

5.2.7 Regarding the materials/finishes used for the fencing, all fencing at the substations will have a standardised galvanised finish. The fencing cannot be painted due to future maintenance issues, see information as detailed above, so there is no scope for variation.

5.2.8 The vehicle gates to the substation compound will match the heights and specification of the boundary treatments.

Substation Roads, Footpaths and Other Surfacing

5.2.9 To ensure proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75 mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

5.2.10 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application (**Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**) include parking spaces. The number of spaces is judged on a site-by-site basis. Further detail on access is provided in the **DAS [REP2-020]**.

5.2.11 For the external access roads, they would be constructed using an impermeable surface such as asphalt or concrete respectively. The requirement for substation surfacing is that it should need little to no maintenance (for up to 40 years), be load bearing and protected from spillages (fuel/oil). Given these requirements, it precludes the use of unbound material so there is no scope for variation in the surfacing of the access roads.

5.2.12 Where the permanent accesses are impermeable SuDS will be installed to collect, treat, attenuate and discharge the runoff from the road. SuDS best practice shall be used including the prioritisation of infiltration techniques close to the source where possible.

Tilbury North Substation

Size and Layout of Substation Compound

5.2.13 While AIS technology is a mature and proven approach, its deployment in this location is significantly prevented by land availability, environmental considerations, and limited scalability. In contrast, the preferred GIS solution presents a more robust and future-proof option. It avoids conflicts with statutory land-use stakeholders, and simplifies construction by reducing site footprint and complexity.

5.2.14 The GIS technology proposed at Tilbury North Substation allows electrical equipment to be placed closer together compared with conventional AIS, due to its use of insulating gas. As a result, the overall footprint of the substation is reduced, albeit the need for the required separation distances still limits the flexibility in terms of reducing the footprint further. Equipment such as transformers and shunt reactors will require adequate clearances and bunding (where applicable) to prevent fire spread

and environmental contamination. An acoustic enclosure may also be provided for noise attenuation, although this does not significantly alter the spatial requirements. A noise survey is required to determine if the equipment (shunt reactor) requires an acoustic enclosure and this would be carried out at the detailed design stage.

5.2.15 AIS has much greater land requirements and would encroach substantially onto adjacent land uses. Depending on the orientation, affected land uses would include, a working aggregates/closed landfill site, Orsett Golf Course, areas of woodland including ancient woodland (an irreplaceable habitat), replacement ancient woodland mitigation areas associated with the LTC proposals, and a local wildlife site. It is also possible that Special Parliamentary Procedures would be required for some areas (leading to a potential delay of up to two years) to secure the necessary land rights.

5.2.16 While some aspects of the potential effects may be capable of being addressed through compensation, it is recognised that the closure of a high-profile golf course would have a substantial community effect and is not considered acceptable in this case when an alternative technology is available. The GIS substation minimises these interactions and is proposed as the preferred technology.

5.2.17 These advantages in combination with the disadvantages of using AIS collectively make GIS the most practical and resilient choice to support long-term system reinforcement and network reliability.

5.2.18 Further details on the design considerations are provided in the **5.15 DDR [APP-122]**.

Arrangement of the Substation

5.2.19 As shown in image 6 and 7, the proposed Tilbury North Substation will be located on a greenfield site approximately 5 km north of the existing Tilbury Substation, in Tilbury Essex.

5.2.20 The layout of the substation has been influenced by site-specific factors including proximity to existing utilities, environmental constraints such as the adjacent Orsett Golf Course, and the need to connect to multiple new and existing overhead line routes. A dry valley runs along the eastern edge of the site, with a surface water flood path indicated. The site has been selected through an optioneering process to minimise impacts on these constraints while providing optimal connectivity into the existing 400 kV network and EACN Substation. Further details are provided in the **5.15 DDR [APP-122]**.

Electrical Equipment

5.2.21 There is no scope to vary the colour and finish of the electrical equipment inside the GIS hall. Modular steel fabricated building and cladding for the buildings are typically specified in standard industrial finishes (such as metal sheeting), which are selected to minimise maintenance and withstand environmental exposure. External steel support structures and enclosures would be finished in galvanised steel or appropriate protective coatings.

Finished Site Level

5.2.22 The existing site at Tilbury North slopes from north to south, ranging from approximately 28 m AOD at the northern edge to approximately 16 m AOD at the southern edge. The extent of the substation boundary is constrained along the

northern and western edges by Orsett Golf Course, a working aggregates processing/closed landfill site and an area of environmental importance.

5.2.23 The site finish level at Tilbury North Substation is shown as approximately +21.150 m AOD on AENC-MMAC-ENG-DWG-0085-21 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).

5.2.24 Non-linear infrastructure located within the substation have a 15 m maximum height and an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the **2.3 Works Plans [REP4-016]**.

5.2.25 To mitigate flood risk and create a level working platform, the substation platform will be raised above existing ground levels and significant earthworks, including retaining structures, will be undertaken

5.2.26 The finished platform level will form the basis for determining the height parameters for structures and buildings. The platform design must ensure effective drainage and compatibility with overhead line gantry levels, particularly due to the elevation difference with the adjacent Orsett Golf Course. This would be determined at the detailed design stage.

Substation Buildings

5.2.27 For the GIS control buildings, there is scope for variation in the external finishes. Buildings must be located with due consideration for access, maintenance, and operational clearance. These buildings are expected to be modular steel-fabricated with metal sheet cladding for the GIS hall but may allow variations in colour to suit the surrounding landscape.

5.2.28 The GIS building will have maximum dimensions of approximately 135 m x 30 m x 15 m (length x width x height) and will house all high-voltage equipment. An associated annex building (approximately 135 m x 12 m x 15 m) will contain auxiliary equipment and welfare facilities. Prefabrication may be considered where appropriate to reduce on-site construction time and improve safety.

5.2.29 Smaller prefabricated buildings, fibreglass or steel containers or enclosures may be required for specific systems, such as protection or communication equipment. These may be fibreglass or metal containers/structures. The approach to the detailed design of Tilbury North Substation involves using a combination of cladding and modular steel frame for the GIS hall and annex buildings.

5.2.30 There are existing buildings to the north of Orsett Golf Course that have a ribbed metal cladding roofs and horizontal clad walls so the materials would reflect the local vernacular of similar large scale functional buildings, seen in image 326 This is likely to involve the use muted, ribbed metal cladding similar to Yaxley Substation.

Images 5.1 Example of a building to the north of Orsett Golf Course (Source: Google Streetview 2025)

5.2.31 For the GIS substation building it is recommended to have muted and matt colours such as RAL 110 30 10 Dark Olive Green or similar to those identified in the colour palette in image 21.

5.2.32 For any reused and/or relocated buildings, any cladding material proposed shall either be of identical specification to that of the existing cladding or, if a proposed change is requested by the relevant Local Authority, it must be compatible with the structure of the existing building. If no compatible alternative is available, the existing cladding material shall be reused on any relocated building, if practicable.

Summary

5.2.33 The Design Review Panel may provide comments and recommendations on the following aspects of the Tilbury North Substation, with any subsequent design changes being considered by the Design Executive in accordance with the agreed design governance arrangements:

- The landscape mitigation proposals
- Colour and finish of the acoustic enclosures (if required).

5.2.34 The final colour of the GIS building and gas insulated hall annex, at the Tilbury North Substation is captured by Requirement 11.

EACN Substation

Size and Layout of Substation Compound

5.2.35 The preferred design solution for the EACN building was AIS, as it was considered that despite a larger footprint, it would fit better into the surrounding landscape and would be easier to visually screen compared to GIS technology, as there would be less massing to screen than if a building was used. It has reduced visual effect by virtue of generally lower height equipment. As there are no large-scale buildings in this area, the visibility of structures is likely to be reduced and mitigation is likely to be more effective in screening views towards the substation, when compared to GIS technology.

5.2.36 In this case there was sufficient land available to accommodate this design. Further details are provided in the **5.15 DDR [APP-122]**.

Arrangement of the Substation

5.2.37 As shown in the image 23, the EACN Substation consists of a single electrical compound containing the 400 kV equipment. Within the overall compound, a control building is separately fenced off to prevent unauthorised access to the main electrical high voltage compound. The compound consists of a security fence, control buildings and vehicle access, including for large vehicles such as cranes, heavy goods vehicles and abnormal loads to deliver and remove the transformers and reactors if required.

5.2.38 At the EACN Substation, the proposed 400 kV underground cable approaches from the west from Bramford Substation. The 400 kV overhead line also exits the substation from the west towards Tilbury North Substation.

5.2.39 The substation has been located with both local constraints and the contracted connecting customers in mind. The EACN Substation is located to the east of a network rail owned railway track which the Project's overhead line and underground cable then must cross. By doing so it avoids causing multiple additional track crossings stemming from the corridors that would be required to accommodate North Falls offshore wind farm and Five Estuaries offshore wind farm and Tarchon Energy Limited Interconnector when connecting to the EACN Substation. See **5.15 DDR [APP-122]** for more information.

Electrical Equipment

5.2.40 There is no scope to vary the colour and finish of the electrical equipment needed. Typically, busbars and clamps are manufactured from aluminium (dull silver grey). Insulators are either porcelain (usually reddish brown/grey) or silicone (usually grey) and the manufacturers of equipment vary in their preference. Steel support structures within the compound would be left in a galvanised finish (dull silver grey) to avoid maintenance requirements in close proximity to 'live' equipment.

Finished Site Level

5.2.41 The proposed substation has been located out of all flood zones and therefore does not pose a flood risk as per national planning requirements. However, for National Grid policy, a 1:1,000 year + climate change flood resilience level is required. The site finish level is shown as approximately +36.25 m AOD on the Substation Elevation drawing AENC-MMAC-ENG-DWG-0085-15 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C). The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the maximum height of the non-linear infrastructure located within the substation would be 15 m with an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the **2.3 Works Plans [REP4-015]**.

5.2.42 The substation platform has been designed to be outside of the 1% Annual Exceedance Probability (AEP) +30% climate change flood extent so that there is no requirement to provide compensatory flood storage. Site access and egress is entirely via Flood Zone 1.

Substation Buildings

5.2.43 The DCO application illustrates a number of buildings within the EACN substation, including:

- Central control building
- Amenities building
- PRR buildings
- Dynamic Reactive Compensator (DRC) buildings
- Acoustic enclosures (if required)

5.2.44 These are described in Section 4.2 of this DASSI and illustrated 2.6.1 Design and Layout Plans – Subs and Cables (Revision C).

5.2.45 Smaller prefabricated buildings, fibreglass or steel containers or enclosures may be required for specific systems, such as protection or communication equipment. These may be fibreglass or metal containers/structures.

5.2.46 Buildings must be located with due consideration for access, maintenance, and operational clearance.

Summary

5.2.47 The Design Review Panel may provide comments and recommendations on the following aspects of the EACN substation, with any subsequent design changes being considered by the Design Executive in accordance with the agreed design governance arrangements:

- The landscape mitigation proposals
- Colour and finish of buildings, comprising:
  - Central control building
  - Amenities building
  - PRR buildings
  - Dynamic Reactive Compensator (DRC) buildings
- Colour and finish of the acoustic enclosures on site (if required)..

Connection Works at Norwich Main Substation

5.2.48 Given the nature of the connection works at Norwich Main Substation there is limited scope to vary the size and arrangement of equipment or the colour and finish of materials.

5.2.49 The Project connection at Norwich Main Substation is being connected into the approved extension which is currently being constructed and does not form part of the scope of this Project. This was approved by South Norfolk Council in September 2024 (planning reference 2024/1336). Therefore, the extent of the Project's works within the Norwich Main Substation are limited to the population of two feeder bays. These are made up of 400 kV AIS equipment and are to be provided within the live electrical compound being established by third parties, therefore there is no scope to alter the size and layout of this equipment.

Extension to Bramford Substation

Size and Layout of the Connection Works

5.2.50 The Project connection at Bramford Substation is being connected into a new extension of the main 400 kV GIS substation. The Project has a direct interface on site with the Bramford to Twinstead Network Optimisation scheme as both projects traverse the same areas of site and are required to integrate together. It is for this reason GIS equipment has been selected for installation as it allows circuits to be built closer together and minimises the land take requirements. There are minor amendments required to the north and south of site to accommodate new line entry gantries which will require the existing fencing to be reconfigured; however, these changes are limited. Given this is an existing site, the plan is to match the design and colour schemes already implemented on site to aid in blending the new equipment into the surroundings. Due to the limitations of existing development around Bramford Substation no landscaping has been proposed.

Finished Site Level

5.2.51 The proposed connection works have been located out of all flood zones and therefore do not pose a flood risk as per national planning requirements. However, for National Grid policy, a 1:1,000 year + climate change flood resilience level is required. The site finish level is shown as approximately +56.250 m AOD on AENC-MMAC-ENG-DWG-0085-12 within the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C). The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the maximum height of the non-linear infrastructure located within the substation would be 15 m with an upward vertical LoD of 10%. The vertical limits (in relation to height) are defined in Article 5 of the DCO and presented in Parameter Tables within the **2.3 Works Plans [APP-018]**.

5.2.52 The substation platform has been designed to be outside of the 1% AEP +30% climate change flood extent so that there is no requirement to provide compensatory flood storage. Site access and egress is entirely via Flood Zone 1.

5.2.53 Given the majority of the site is existing National Grid infrastructure, the works will be constructed to the same established site levels for ease of construction.

Substation Buildings

5.2.54 The main site is to be extended and the new buildings will match the existing substation buildings in terms of design, materials and finishes.

Summary

5.2.55 The Design Review Panel may provide comments and recommendations on the following aspects of the Bramford substation extension with any subsequent design changes being considered by the Design Executive in accordance with the agreed design governance arrangements::

- Colour and finish of the new GIS Building
- Colour and finish of the northern and southern extension to the GIS Building (although it is expected that the extensions would match the existing GIS Building on site).

5.3 Landscape and Visual Mitigation

Design Principles

5.3.1 Environmental appraisal has been an integral part of the Project design from the outset, which has meant that the Project has been able to avoid environmentally sensitive features as far as reasonably practicable.

5.3.2 National Grid has also embedded mitigation into the design of the Project to avoid or reduce significant effects that may otherwise be experienced during construction and operation (and maintenance) of the Project.

5.3.3 Embedded mitigation measures are those that are intrinsic to and built into the design of the Project. These are presented in Table 4.2 of **Chapter 4: Project Description [APP-130]**. Those relevant to Landscape and Visual Amenity and the DASSI document include:

- Sensitive siting of the CSE compounds and substations and Order Limits - as far as practicable effects on identified environmental (including landscape and visual, ecology and heritage assets) and socio-economics receptors have been avoided and reduced
- The Project allows for landscape planting around CSE compounds, the new EACN Substation, south of the new Tilbury North Substation and the existing Norwich Main Substation and its extension. These are shown as 'Environmental Areas' on **Figure 4.1: Proposed Project Design [REP4-109]** and **Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**. The Outline LEMP (document reference 7.4) has been produced to detail the environmental measures that would be implemented to avoid, minimise, mitigate and compensate the landscape and visual and ecological features likely to be impacted during construction and operation. These are shown in image 2 to 9 above.
- New planting is illustrated on the indicative landscape proposals, within Appendix D of the 7.4 Outline LEMP, including planting schedules, (Revision B), will also contribute to BNG.

5.3.4 The Environmental Areas compromise of the following:

- Land around Norwich Main Substation (areas not included in the Norwich Main Substation Extension Planning application)
- Land around EACN Substation
- Land around Tilbury North Substation and YYJ CSE Compound Tilbury North and Warley Side (with LTC)
- Land around Wenham Grove CSE Compound
- Land around Great Horkesley (EACN Side) CSE Compound
- Land around Great Horkesley (Tilbury Side) CSE Compound
- Land around Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds.

5.3.5 The extension to Bramford Substation is not an area identified for mitigation planting over and above reinstatement planting, as there is not sufficient space due to other planned developments. Reinstatement planting is secured under Requirement 9 in the form of the scheme for replacement planting in the draft DCO (refer to Schedule 3 of the draft 3.1 DCO (Revision E)) and details would be provided upon completion of the detailed engineering design to avoid abortive design work.

5.3.6 The principal objective of the mitigation within the Environmental Areas is to filter and screen views of the infrastructure from people living and moving around the landscape, whilst also aiming to integrate the infrastructure into the landscape in a way that respects and enhances landscape character. The overarching design principles for the landscape and visual mitigation of the CSE compounds and substations are secured via the outline LEMP, with the final LEMPs to be submitted under Requirement 4 (refer to Schedule 3 of the draft 3.1 DCO (Revision E), and have been outlined below:

- Develop proposals taking into consideration the baseline landscape context as outlined in Chapter 2
- Retain existing trees, woodland and hedgerows where practicable. A site survey of all hedgerows and trees to be retained would be carried out to establish up to date requirements for reinforcement, including any incidence of ash dieback. The survey would also identify potential locations of new tree planting taking into account more detailed information on constraints such as services. The detailed landscape mitigation design would also need to reflect the final locations of permanent visibility splays and other technical constraints. Reinforce existing field boundary hedgerows and restore historic hedgerows where possible through additional native shrub and tree planting to strengthen landscape character. Maximise green infrastructure links and biodiversity and filter and screen views of new infrastructure
- Replacement planting would be undertaken at the earliest opportunity within the appropriate planting season to mitigate, where practicable, vegetation removed during construction
- New planting to reflect the overall pattern and composition of woodland blocks and belts in the vicinity of the substations and CSE compound sites, noting the greater quantum of existing woodland cover in the vicinity of the Tilbury North Substation in particular
- Adoption of permanent, subtle earth mounding generated from construction phase excavation with appropriate heights and slope profiles and native scrub and woodland planting to minimise adverse landscape and visual effects and achieve a cut and fill balance of material at each substation and CSE compound site

5.3.7 Drainage would also be required and would comprise attenuation ponds (or alternative feature) and outfalls as presented on **ES Figure 6.4.2: Proposed Project Design – Permanent Features [REP-110]**. The detailed landscape mitigation proposals would reflect the indicative landscape proposals and would be developed from the fixed engineering design. Regard would be had to nearby developments, in particular to the substations and associated cables for the North Falls and Five Estuaries offshore wind farm projects which have been assessed in Chapter 17 Cumulative Effects Assessment of the **ES [REP4-163]**. The proposals for the Environmental Areas are secured via the outline LEMP with detailed proposals being

provided in the LEMP to be submitted under Requirement 4 (refer to Schedule 3 of the draft 3.1 DCO (Revision E).

5.3.8 There would be opportunities for the relevant Local Planning Authorities to suggest minor changes to the planting palette and/or request minor changes to the earthworks and extent of planting, subject to these changes being non-material, in general accordance with the outline LEMP and compatible with the detailed design of underground services and drainage and above ground easements related to infrastructure.

5.3.9 The following images show the Environmental Areas around the CSE compounds and substations, illustrated with planting at year 15. Whilst the images are based on the Environmental Areas they are for illustrative purposes only (including access surfacing). They have been verified by the landscape specialists in the LUC team and the reader should defer to the detail shown in the Environmental Areas provided in the Outline LEMP (document reference 7.4) for specific landscaping details and proposed management and Image 1.2 through Image 1.8 detailed above.

Image 5.2 Wenham Grove CSE Compound illustrated with planting at year 15

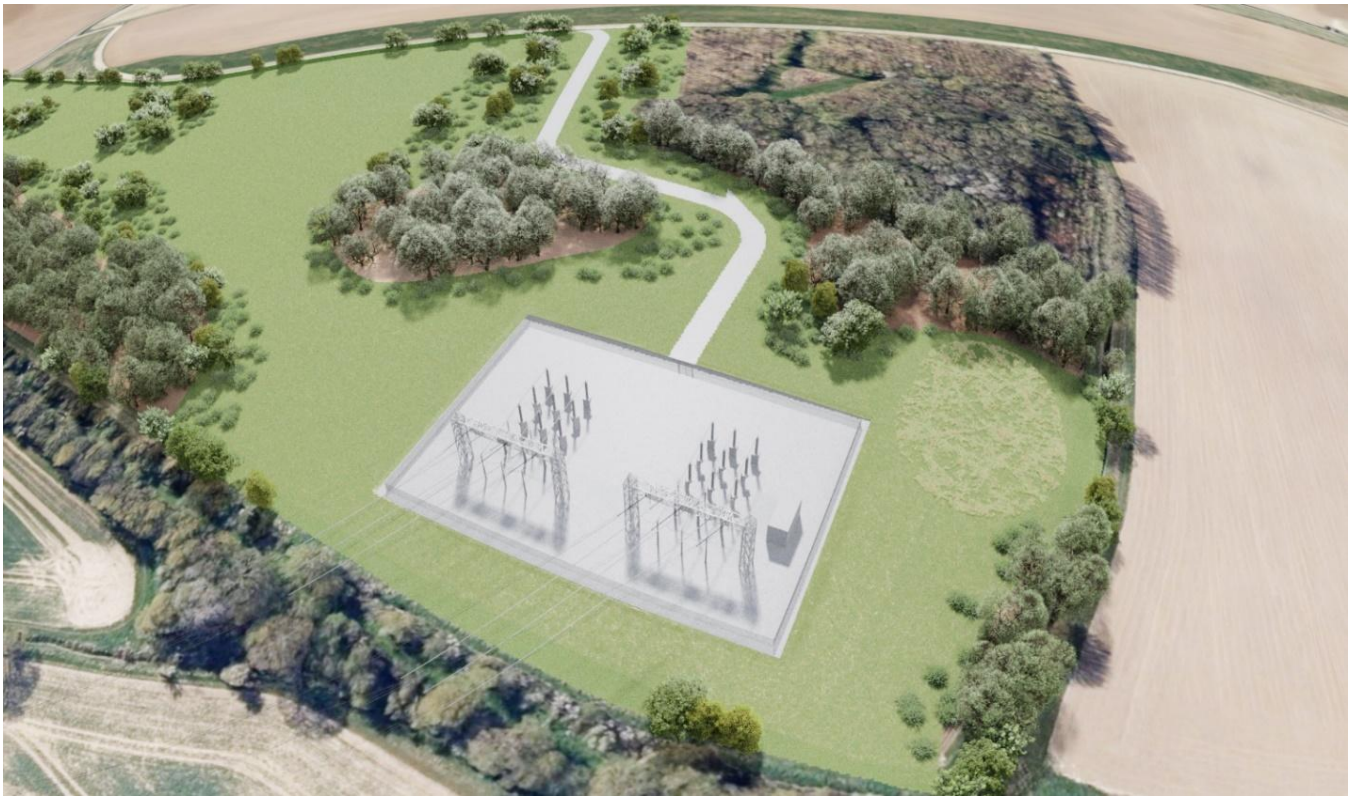


Image 5.3 Great Horkesley (EACN Side) CSE Compound illustrated with planting at year 15

Image 5.4 Great Horkesley (Tilbury Side) CSE Compound illustrated with planting at year 15

Image 5.5 Fairstead (EACN Side) and Fairstead (Tilbury Side) CSE Compounds illustrated with planting at year 15

Image 5.6 Tilbury North (Tilbury Side) and Tilbury North (Warley Side) CSE Compounds Footprint illustrated with planting at year 15

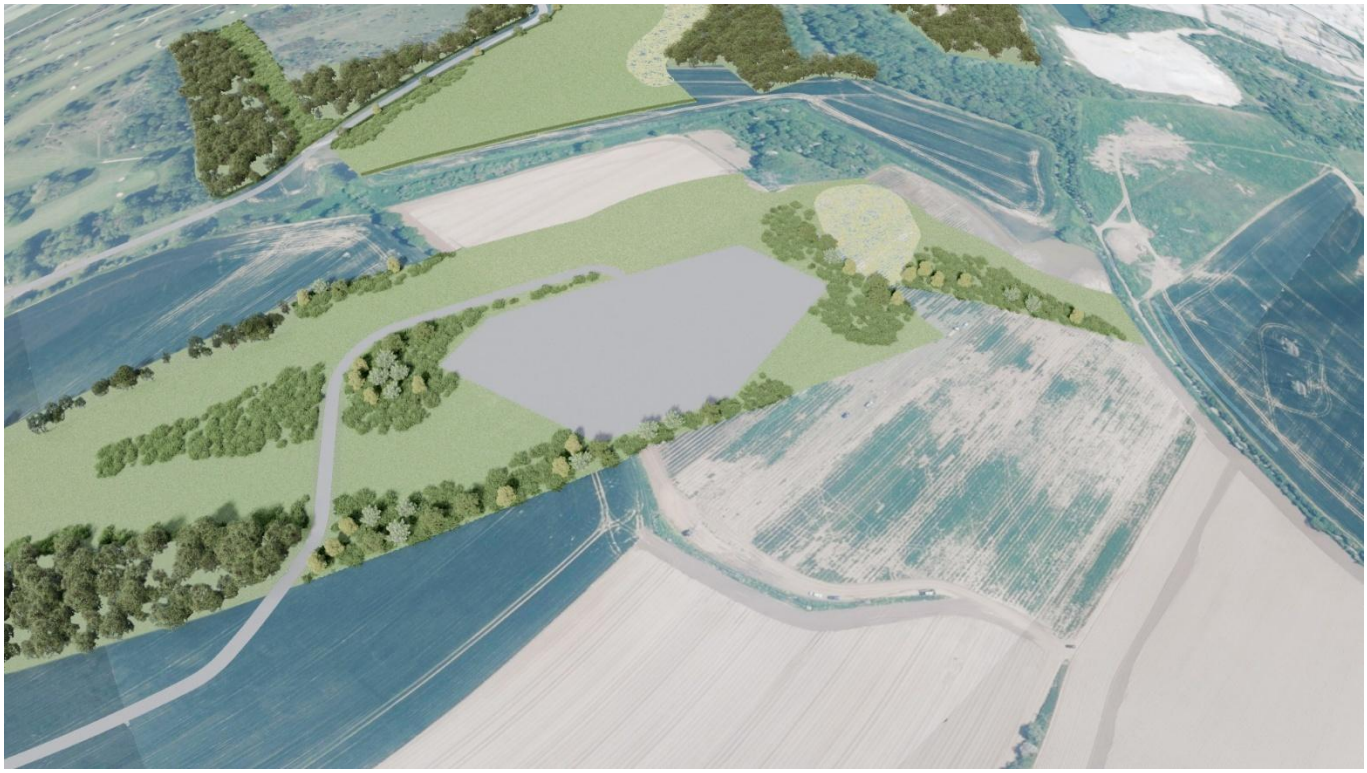


Image 5.7 Tilbury North Substation illustrated with planting at year 15

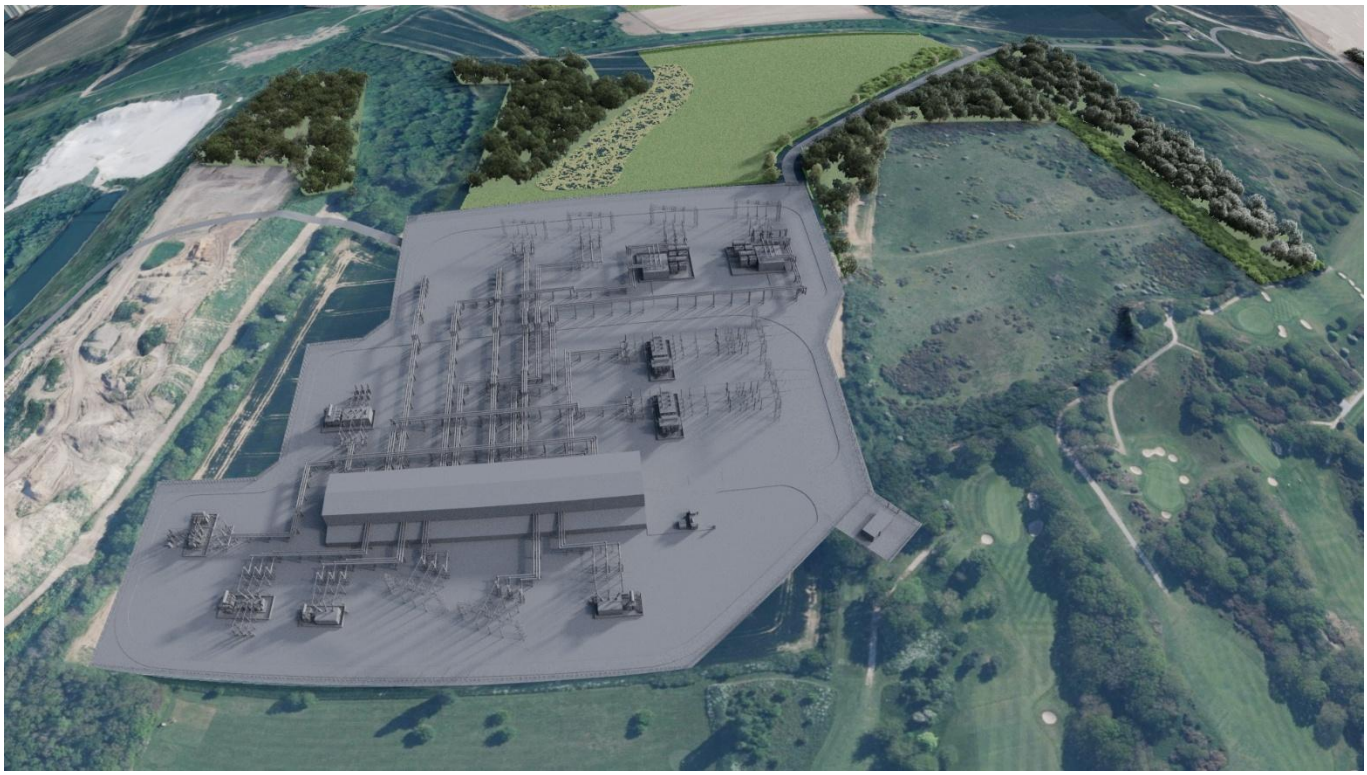


Image 5.8 EACN Substation illustrated with planting at year 15

Scope for Variation

5.3.10 A range of technical constraints reduce the scope for variation in the design of landscape mitigation including the following:

- Tree planting must be located outside the easements of overhead lines and the downleads in the vicinity of the substations and CSE compounds. A current indicative offset of 28 m from the centre line of the overhead lines with final offset distances to be confirmed at detailed design stage
- Clear space is required beneath the downleads from the overhead line to maintain safety clearances, which restricts both tree planting and earth mounding
- A minimum offset of 3 m is required for tree planting from the security fencing associated with the substations and CSE compounds
- There is a requirement for an offset both sides of the outer cable swathe to avoid impacts on the cables. The current indicative offset is 10 m from the outer extents with final offset distances to be confirmed at detailed design stage
- Tree planting must also be located outside the easements of pre-existing services such as gas and water pipes in accordance with relevant guidelines
- There are restrictions to planting related to permanent visibility splays required for permanent access to substations and CSE compounds.

5.3.11 Whilst there is some scope to vary the mitigation proposals within the Environmental Areas in terms of detailed layouts and types of proposed planting; at the detailed design stage there is no scope to vary the size or locations of the proposed Environmental Areas within the Order Limits. These Environmental Areas have been developed in consultation with relevant Local Planning Authorities and Natural England. These will be subject to design details to be secured via the LEMPs to be submitted under Requirement 4 (refer to Schedule 3 of the draft 3.1 DCO (Revision E).

5.4 National Infrastructure Design Principles

5.4.1 The Applicant acknowledges that the National Policy Statement for Energy (2024) adopts a holistic approach to good design, recognising that good design extends beyond matters of appearance and encompasses functionality, sustainability, place sensitivity and the mitigation of environmental effects. Paragraphs 4.7.1 to 4.7.4 make clear that good design is a means by which a range of policy objectives can be achieved, including the mitigation of adverse effects through appropriate siting, layout, technology selection and design development. NPS EN-1 further emphasises the importance of embedding good design throughout the project lifecycle, with design principles established at an early stage to guide project evolution (paragraphs 4.7.5 to 4.7.7). In the context of landscape and visual effects, paragraph 5.10.19 confirms that landscape and visual considerations should inform site selection and design development from the outset, while paragraph 5.10.37 requires the Secretary of State to consider whether a project has been carefully designed to minimise landscape harm, taking account of environmental, operational and other relevant constraints. The Applicant also notes paragraph 5.10.30, which states that the Secretary of State should be satisfied that sufficient design content is secured to enable local authorities, through future approval processes, to ensure that landscape, visual and good design objectives continue to be achieved. Accordingly, while the

Design Review Panel (described in Section 6 of this DASSI) may provide input on a limited range of detailed design matters, the wider principles of good design are embedded within the project's design governance framework and secured through the Development Consent Order and associated design controls.

5.4.2 Acknowledging holistic approach to good design, the Applicant has identified a series of Design Principles to inform the Design of the Project.

5.4.3 In October 2024, new guidance for Nationally Significant Infrastructure projects was published by the Planning Inspectorate. This guidance recommends that developers should explain how they respond to the four design principles of climate, people, place and value published by the National Infrastructure Commission.

5.4.4 This section details how the Applicant has applied these design principles in the design to date, and how they will be considered as the detailed design is developed post consent.

5.4.5 Similarly to the Advice on Good Design, the NIC Design Principles have been given due regard during the development of the Project. The following sets out how the Project has considered the overarching NIC Design Principles.

Climate

5.4.6 National Grid has assessed potential impacts of climate change and incorporated adaptation/resilience throughout the lifetime of the Project. Section 5.3 of the DAS sets out the ‘sustainability vision’ of the Project and details how the Project has been designed to be resilient to climate change.

5.4.7 BNG plays a pivotal role in climate change mitigation and adaptation. The Project has committed to delivering 10% BNG.

5.4.8 The Project would make an important contribution to reducing Greenhouse Gas and reaching the UK government’s target of net zero by 2050, by supporting the distribution of greener energy.

People

5.4.9 The Project will deliver resilience, security and diversity of supply that will deliver secure, diverse mix of clean energy to homes, businesses, hospitals and schools.

5.4.10 The Applicant has sought the views of local communities throughout the Project to ensure the design complements the local character and culture and provides meaningful benefits to local communities. Extensive non-statutory, statutory and targeted consultation have taken place since 2022.

5.4.11 The Applicant has sought opportunities to minimise disruption to the quality of life for people who live and work nearby and taken steps to mitigate potentially adverse effects and disruption. As set out in Paragraph 4.7.5 of NPS EN-1 there is a requirement on applicants to consider how their design principles will be applied post consent. National Grid proposes to utilise the Design Advice Panel and Design Champions to ensure that the design principles are carried through into detailed design.

5.4.12 National Grid has considered the potential impact of the Project on local people and receptors in the ES, specifically in the Residential Visual Amenity Assessment (RVAA) which assess the potential impact of the Project upon residential amenity.

The assessment concludes that the residential visual amenity threshold would not be breached by the Project.

Places

5.4.13 The Applicant has looked for opportunities to use infrastructure to benefit the natural environment, to see how interventions can deliver improvements to sustain local ecosystems. The Project has committed to achieve a minimum of 10% BNG (through onsite and offsite BNG).

5.4.14 The Project is for new electricity generation infrastructure that when delivered will have wider benefits to the community, delivering clean, secure and affordable clean power to the benefit of communities and wider society.

Value

5.4.15 The Project Team consists of a multi-disciplinary design team who have worked on the Project since the Strategic Option Stage up to submission and through the Examination phase. The GGP has been established by National Grid to support the delivery of the Project and to progress detailed design.

5.4.16 National Grid has appointed a Development Design Champion to provide oversight of advocacy for ongoing good design through the DCO process and will appoint a second Delivery and Detail Design Champion to support development and implementation of the Project. National Grid will also appoint a community relations team to act as the main point of contact for local residents, businesses and stakeholders during both pre-construction and construction phases.

5.5 Substation Design Co-ordination Design Principle

A Joint Substations Design Guide (JDG) has been prepared by North Falls and Five Estuaries to support the development of detailed proposals for those projects co-located onshore substations. The JDG will be used to help inform the final design of the onshore substations and focuses on areas where collaboration can help minimise the impact of the substations and explore areas for improvement, such as enhancing biodiversity for the environment and surrounding communities. By combining the projects' indicative layouts and establishing shared aims and objectives, the JDG provides coordinated design guidance for the landscape and wider site. This ensures a consistent and harmonised strategy and supports alignment at the detailed design stage through each project's relevant documentation e.g. LEMP, EMP and Written Landscape Scheme (WLS). It also provides assurance that these documents will remain coordinated as they are developed, reflecting the co-location of the substations and the need for aligned plans and documentation.

The Project will have regard to the conclusions of the JDG. This approach will result in a more cohesive and holistic design that includes co-ordination of the proposed cumulative infrastructure. The Design Review for EACN will include consideration of landscape proposals for North Falls and Five Estuaries to tie together a coherent landscape scheme.

Role of the Design Review Panel

5.5.1 As summarised above, the Design Review Panel may provide comments and recommendations on the following design aspects of substation, with any subsequent design changes being considered by the Design Executive in accordance with the agreed design governance arrangements:

- Landscape mitigation proposals
- Colour and finish of buildings, including:
  - Central control building
  - Amenities building
  - PRR buildings
  - Dynamic Reactive Compensator (DRC) buildings
- Colour and finish of acoustic enclosures (if required)

5.5.2 It will not be possible to collaborate on design matters related to the configuration and / or design of operational electricity infrastructure. National Grid designs its substations according to a set of safety instructions, policies, standards and guidance notes based on international standards. A substation layout is designed to protect staff working within, the wider public, local community and environment, protect the equipment in the substation and allow safe access to install, maintain, or remove all or part of the substation.

5.5.3 The configuration of electrical infrastructure is constrained by operational, constructional and technical requirements. Due to the functional nature of these components there is no optionality to alter their position or to consider alternative colour or material finishes.

5.6 Link Pillars Design Co-ordination Design Principle

Siting and Appearance

5.6.1 The link pillars have typical dimensions of 2 m x 0.7 m x 1.5 m plus, for example, a timber fenced area around them, typically 3 m x 4 m. Where link pillars are grouped together, two cabinets would be located adjacent to each other (back-to-back) and the surrounding fenced area would be approximately 4 m x 4 m. This is depicted in 2.6.1 Design and Layout Plans – Subs and Cables (Revision C)), drawing (AENC-MMAC-ENG-DWG-0085-06A).

Technical Requirements and Limitations

5.6.2 Although detailed system design is required to confirm the number and location of link pillars, it is considered likely that one link pillar per cable trench (group of three cables) will be required as shown within drawing AENC-MMAC-ENG-DWG-0085-06. It is also considered likely that cable section lengths will be similar, resulting in the grouping of joint bays and the associated link pillars, resulting in a maximum of six link pillars at each joint bay grouping. Where practicable the link pillars will be co-located in small compounds with timber post and rail fences. The number and size of the fenced-off areas will depend on the specific location and land use and may be one larger area or more likely two or three smaller areas.

5.6.3 The link pillar locations are dependent on the length of the cable sections which can be influenced by the detailed cable system design, the crossing constraints along each section and the access constraints. It is therefore not possible to confirm overall numbers or locations of link pillars until detailed design has been undertaken. Numbers and locations of link pillars are largely decided by the technical requirements of the cable system.

5.6.4 Economic, environmental and technical drivers for cable system design are to maximise the section length and minimise the number of joint bays. Limitations on the transportation of cable lengths terrestrially via HGV, and specifically the size and weight of the transport vehicle, mean that cable lengths are limited to approximately 1 km in length. However, constraints along the alignment of the route including trenchless crossings under various constraints and the suitability of access routes can further impact the available length of each cable section. The cable system design and preferred bonding strategy can also impact the section lengths. Taking a reasonably worse case, an average cable section length of 800 m can be assumed, although some sections may be shorter they would be outweighed by longer sections elsewhere along the route. This is technically preferred from a maintenance point of view, as joints are more likely to require maintenance than cable sections mid-span.

5.6.5 The Applicant's duties to protect the environment (incorporating duties to protect National Landscapes) would further influence the numbers and locations of link pillars. Land use and visual impact are factors in locating link pillars.

5.6.6 Where practicable, link pillars are located towards the edges of fields when in open country or agricultural land, however, the constraints of the cable system design can restrict the flexibility for micro-siting link pillars. The bonding cables have an approximate maximum length of 15m, therefore the link pillars need to essentially be located adjacent to the cable joint.

Boundary Treatment

5.6.7 As illustrated on Image 4.5, the link pillars would be enclosed within a timber post and rail fence.

5.6.8 The height of the surrounding post and rail fence would typically be similar to the agricultural fencing encountered in the same area. Where large livestock may be present, higher fencing will be specified to ensure the link pillars remain sufficiently protected. In accordance with BS 1722-7 guidance the height of a wood post fence shall typically be a maximum 1.3 m.

Access

5.6.9 No physical access track is required to service the link pillars. Maintenance access would typically be made by 4x4 vehicles, using existing accesses (field gates etc and travelling over the field).

Surface Treatment

5.6.10 The surface treatment within the compound would typically be reinstated soil, seeded with grass, as can be seen in 2.6.1 Design and Layout Plans – Subs and Cables (Revision C), drawing AENC-MMAC-ENG-DWG-0085-06A, which provides an example image of a pair of link pillars for further context.

5.6.11 Other surfacing may be considered where appropriate, for example in scenarios where the link pillars are located adjacent to existing hard standing areas, crushed granular material may be used. Crushed granular material or paving slabs may be used immediately adjacent to the doors of the link pillar to retain a clear working space.

External Appearance

5.6.12 The appearance of the Link Pillars primarily derives from its functional need and the safety requirements of the development. The colour of the link pillar is a matter which could be subject to Design Panel Review.

Summary

5.6.13 The Design Review Panel may provide comments and recommendations on the following aspects of the link pillars, with any subsequent design changes being considered by the Design Executive in accordance with the agreed design governance arrangements:

- External colour of the link pillar cabinet
- Fence height a wood post fence shall typically be a maximum 1.3 m,
- Surface treatment typically this will be reinstated soil, seeded with grass, other surfacing may be considered where appropriate.

5.7 Nature Recovery Strategies and Local Green Infrastructure Design Principle

5.7.1 The overarching design principles for the landscape and visual mitigation of the CSE compounds and substations are secured via the outline LEMP, with the final LEMPs to be submitted under Requirement 4 (refer to Schedule 3 of the draft DCO (document reference 3.1), and have been outlined below:

5.7.2 Indicative landscape proposals for each of the Environmental Areas are included in Appendix D of the Outline Landscape and Ecological Management Plan (Revision E). At detailed design stage the species mixes within the final landscape designs for the Environmental Areas will be guided by the local context of each mitigation area, with reference to information from the Local Nature Recovery Strategy (LNRS) where available and feasible.

5.7.3 The Project will prioritise the replanting for individual trees and small groups of individual trees within the Order Limits, offsite provision may however be required and will align with the relevant LNRS as far as practicable.

5.7.4 The relevant LNRS will be a key part of the site selection criteria for offsite BNG.

6. Approach to Detailed Design and Approval Process

6.1 Detailed Design

6.1.1 Section 5.2 identified that in relation to the new substations proposed, there was scope for variation in the external colour of the GIS building within the Tilbury North Substation. This Chapter provides details of the approach to the materials to be used on the building, suggested approach for the external colour and how it will be secured. It is considered the proposed colour palette for Tilbury North Substation should be sensitive to the environment it is located in, where practicable.

6.1.2 As stated in Section 5.2 in addition to the external colour of the GIS building at the Tilbury North Substation and the landscaping details can be influenced during the detailed design stage for the new substations (Tilbury North and EACN Substations) and the CSE compound sites.

6.2 Design Champion and Design Review

Design Champion Brief

6.2.1 The role and value of project Design Champions in supporting how Good Design will be secured throughout the DCO application, detailed design and construction phases of Nationally Significant Infrastructure Projects, is widely recognised and advocated by the National Infrastructure Commission. The Applicant notes that neither National Policy Statement EN-1 (2024) nor the Planning Inspectorate's Advice on Good Design requires the design champion to be independent.

Design Champion Core Role & Responsibilities

6.2.2 The appointment of a design champion is supported by NPS EN-1, NIC Design Principles and the Planning Inspectorate Advice on Good Design. The core role of a Design Champion is to provide leadership to secure high-quality, sustainable outcomes and drive, monitor, and champion design quality from inception to post-consent and construction. Key Aspects of the Design Champion Role include:

- **Strategic Positioning:** Non-executives operating at board level, ensuring design is not considered solely a technical or aesthetic issue.

6.2.3 Core Responsibilities:

- **Advocacy:** Championing design quality to senior decision-makers.
- **Vision Setting:** Articulating and maintaining the project's design vision and quality aspirations.
- **Guidance:** Ensuring design objectives are embedded in briefings, contracts, and throughout the project life.
- **Evaluation:** Reviewing design quality at key stages.

- **Role in NSIPs:** The National Infrastructure Commission (NIC) requires this role to ensure that major projects, which are subject to Development Consent Orders (DCOs), deliver wider public benefits and align with NIC design principles.
- **Relationship to Governance:** Design Champions often work alongside design panels and are critical for providing a "golden thread" of design, especially post-consent.

6.2.4 The responsibilities and expectations associated with the Design Champion/s roles includes the requirement for individuals who are respected, experienced, skilled and capable of exercising critical judgement – ensure that the appointed Design Champion/s will hold an authoritative position in reviewing detailed design and securing adherence to the agreed design principles.

6.2.5 The role of the design champion for the proposed project has been defined in accordance with the guidance set out in the Institute of Civil Engineers (ICE) 'Defining and Developing the Design Champion Role' 2023, which explains that the role – and the level of resource required to support it – will evolve to reflect different phases of a project. As such, the Design Champion function will be delivered through two complementary roles, whose emphasis will change over time:

- Development Design Champion (DDC), and
- Delivery and Detailed Design Champion (DDDC).

6.2.6 These two appointments fulfil different responsibilities and complementary aspects of the Design Champion role, as follows:

Development Design Champion (DDC)

6.2.7 Design Principles for National Infrastructure (National Infrastructure Commission, 2020) supports design champions within the Project management team to account for delivering on any good design objectives. National Grid has committed to this approach through the appointment of the DDC, a senior figure within National Grid and intentionally chosen from the existing project team for their significant experience and knowledge of the project development to date. Notably, the DDC will be separate to the Great Grid Partnership (GGP) (see DDDC and Governance, below).

6.2.8 The DDC will provide 'internal' oversight and advocacy for ongoing good design through design development and into implementation (with support from a further Design Champion, see below). The DDC is already acting as a critical friend, ensuring that the design principles (based on climate, people, place, and value) seeking to be secured through the DCO and examination process will be upheld through later stages.

Delivery and Detailed Design Champion (DDDC)

6.2.9 In addition to the DDC role, and to provide an Executive Board-level layer of governance, will be The DDDC will be nominated from the Arup–AECOM Joint Venture (AAJV) under the Design Consenting & Environmental Partner of the GGP. This will be a senior member of the GGP, with a minimum of twenty years of experience in significant design and infrastructure projects, recognised across the sector.

6.2.10 The DDDC will be experienced in delivering projects in diverse portfolios including transport, energy, water, property, SIT, social infrastructure, advisory, cities planning and design, technical services, digital, climate and sustainability.

6.2.11 The appointment of the DDDC from the GGP / AAJV provides 'independent' design quality assurance outside the internal National Grid project team, complementary to the DDC.

6.2.12 Taken together, these arrangements for the DDC and DDDC provide a complete Design Champion function across the Project lifecycle, with intentional overlap and a two-way flow of knowledge to maintain continuity of design intent and delivery of Good Design.

Good Design Governance

6.2.13 The Design Champion/s will be key cornerstones to the governance and assurance for achieving Good Design, post-DCO consent. Consistent with the Institution of Civil Engineers recommendations, the DDC will fulfil an advisory role independent of the design team whilst the DDDC will sit at an executive board level, within a tripartite governance structure comprising:

- The Design Champion/s
- The Design Executive (the design team at delivery phase)
- Design Review

The Design Champion/s i

6.2.14 The role of both Design Champions extends beyond the DCO stage into the detailed design and construction phases to ensure that the design principles secured within this DASSI are consistently applied. Both Design Champions will monitor performance of the Project design against these principles and will challenge detailed design proposals where they do not align with the commitments secured through the DCO in the DASSI (the project Design Guide).

The Design Executive

6.2.15 The design team at the delivery phase is the Arup-AECOM Joint Venture (AAJV) that comprises the principal design partner of the GGP.

Design Review

6.2.16 The National Policy Statements for Energy (EN-1 and EN-5 (2024)) do not impose a requirement for applicants to undertake an independent design review. For electricity transmission projects, NPS EN-5 Paragraph 2.4.3 states '…*the Secretary of State should bear in mind that electricity networks infrastructure must in the first instance be safe and secure, and that the functional design constraints of safety and security may limit an applicant's ability to influence the aesthetic appearance of that infrastructure*'. This demonstrates the importance placed on the 'functionality' of design which restricts the extent of design variation.

6.2.17 However, to demonstrate commitment to securing Good Design, National Grid will establish a GGP-led Design Review Panel (DRP) for undertaking design reviews, thereby providing a level of independence to the project.

Image 6.1 Norwich to Tilbury Good Design Governance Structure

6.2.18 The DDC will be part of the panel and will ensure design continuity, independent from the GGP. The DDDC is to work with the Design Executive to help implement, as far as reasonable and practicable, what comes out of design review report, including advice and recommendations.

6.2.19 Both Design Champions will monitor performance of the Project design against the design principles included in the DASSI and will challenge detailed design proposals where they do not align with the commitments secured through the DCO in the DASSI.

6.2.20 The Design Champions will hold an authoritative position in reviewing detailed design and securing adherence to the agreed design principles. The Design Champions will ensure relevant LPAs are invited to participate in Design Review where appropriate at detailed design stage.

Great Grid Partnership Approach to Design Review

6.2.21 The Great Grid Partnership (GGP) is an enterprise model connecting seven industry supply chain partners to help design and deliver major electricity transmission infrastructure projects across England and Wales, on behalf of National Grid. As such, GGP offers the benefit of separation or 'informed independence' to National Grid, with an established design governance, technical and assurance structure. The GGP technical assurance approach forms part of the broader Strategic Infrastructure (Onshore) design governance captured under the Strategic Infrastructure Management System (SIMS) (see Appendix C).

6.2.22 The technical assurance process for GGP is formed of two distinct levels:

- Design Package Assurance: The process where an authorised engineer reviews and accepts engineering deliverables to ensure that design meets the requirements of the scope, is technically sound and compliant with all relevant specifications.
- Design Control Points (DCPs): These are holistic project-level assessments conducted at key stages of development to assess overall engineering confidence. It consolidates all design assurance evidence, reviews project-level design risks and serves as a formal design point to confirm that the project is ready to advance to the next stage of development.

6.2.23 The GGP's relative independence and established design package assurance and design control points provide a unique platform around which to build a project Design Review Panel and broader process. National Grid proposes to establish a Design Review Panel (DRP), hosted by GGP, to undertake robust Design Reviews. The DRP will include multi-disciplinary experts, and a non-project Chair. The structure and function of the DRP has been mindfully composed to include a level separation and will operate independent from the project Executive Design team. This function will be supported by the DDDC, who will not be part of the Design Review Panel but will be responsible for ensuring that recommendations from the Design Review Panel are acted upon, through incorporation within the design.

Design Review Panel

6.2.24 The DRP for Norwich to Tilbury will undertake design reviews post-consent, and is proposed to include the following representatives comprising of multi-disciplinary experts linking good design principles to other topic areas holistically:

6.2.25 Chair – Arcadis Independent Design Advisor

- GGP Design Executive Technical and Design Assurance lead
- Development Design Champion (DDC)
- National Grid Head of Environment and Sustainability
- National Grid Strategic BNG lead
- National Grid Strategic landscape + placemaking lead
- National Grid Community Liaison Officer

6.2.26 The NG Strategic BNG lead attends the post consent Ecology Working Group commenting on BNG and the environmental areas that includes inputs from the local Wildlife Trusts and will represent the holistic nature responsive approach to good design.

6.2.27 Where relevant, the following external stakeholders will also be invited onto the panel:

- Representatives of local planning authorities;
- Dedham Vale National Landscape Partnership Manager;
- North Falls OWF and Five Estuaries OWF project representatives; and;
- Representative of the local Wildlife Trust.

6.2.28 By inviting external stakeholders, this will ensure the design review panel comprises of individuals that are unconnected with the project's promoters and decision makers.

6.2.29 The composition of the DRP has been carefully considered to achieve 'informed independence', striking a balance between internal and external stakeholders, incorporating impartial representatives, local collaborators and National Grid topic leads; thereby blending the spirit of Independent Design Review Panels (IDRPs) with the rigor of deep technical knowledge and delivery expertise.

6.2.30 The panel consists of a Chair and all six core panel members (or their delegates), together with invitations offered to relevant external local stakeholders.

Role of the Panel Members

6.2.31 The Panel Chair will be an experienced and effective person who is responsible for managing the panel discussion and drawing a coherent conclusion for each presentation.

6.2.32 DRP members will be selected to offer advice through a diverse range of collective expertise and professional skills and experience, including subject matter specialists. Some panellists will have in-depth knowledge of the local context and others will have a national expertise, to bring a wide range of perspectives and assurance that a balance of views is on offer.

6.2.33 When providing advice, panel members should act impartially, maintaining objectivity, prioritising a focus on Good Design and compliance with the DASSI over personal stylistic preferences.

6.2.34 Whilst the DRP will not have any decision-making powers, the advice of members will be summarised in a Design Review Report and the GGP Design Executive will need to set out how it has had due regard to incorporating these recommendations, or else justify why this may not have been possible.

6.2.35 Terms of Reference will be prepared for the DRP in support of its governance.

DRP Chair

6.2.36 The proposed Chair of the DRP is proposed to be a Senior Technical Director at Arcadis UK, who has no day-to-day involvement with the project. The Chair will have a minimum of 25 years' experience in multi-disciplinary design projects, with a recognised industry profile. Although not essential, the Chair would benefit from some experience as a panel member of Design Review Panels and/or, similarly, Design Judging Panels, and/or presenting projects to such panels. The Chair should have a full appreciation of the value of the design review process.

Design Review Process

6.2.37 It is anticipated that the DRP will undertake design reviews with reference to section 5 Design Principles and Scope for Variation in Developing the Detailed Design, and DASSI section 6. Accordingly, design reviews will focus only on project infrastructure locations that have the greatest opportunity for further design refinement and meaningful change, as follows:

Table 6.1 Substation Locations

Location	Local Planning Authority
Norwich Main	South Norfolk Council Norfolk County Council
Bramford	Mid Suffolk Council + Babergh District Council Suffolk County Council
EACN	Tendring District Council Essex County Council
Tilbury North	Thurrock Council

6.2.38 Design review for these locations will be offered to include a nominated representative of the relevant LPAs by invitation. For EACN, in addition, the DRP will include representatives of the North Falls and Five Estuaries project teams and seek to have regard to the principles of the Joint Substations Design Guide. This approach will result in a more cohesive and holistic design that includes co-ordination of the proposed cumulative infrastructure, or where there is an overlap of infrastructure and landscape proposals. The Design Review for EACN, for example, will include consideration of landscape proposals for North Falls and Five Estuaries to tie together a coherent landscape scheme.

Cable Sealing End Compounds:

6.2.39 There is limited scope for change to these elements of the scheme and, therefore, the applicant does not propose Design Reviews by the DRP. Instead, detailed design development will be in accordance with DASSI section 5 Design Principles and Scope for Variation in Developing the Detailed Design.

Link Pillars and Compounds:

6.2.40 Whilst there is limited scope for change to these elements of the scheme with regard to design the applicant recognises that in some places Link Pillars will be sited in or close to sensitive landscape areas and, therefore, could be subject to Design Review by the DRP. The parameters of any review are set out in Section 5.6. Link pillars and compounds will be developed in accordance with DASSI section 5 Design Principles and Scope for Variation in Developing the Detailed Design, and statutory approvals process in consultation with the relevant LPAs and Dedham Vale National Landscape Manager, where appropriate to the location.

Environmental Areas around Substations and Cable Sealing End Compounds:

6.2.41 With reference to section 5 Design Principles and Scope for Variation in Developing the Detailed Design proposed Environmental Areas the species mixes within the final landscape designs for the Environmental Areas will be guided by the local context of each mitigation area, with reference to information from the Local Nature Recovery Strategy (LNRS) where available and feasible.

6.2.42 Design Reviews for these locations will be offered to include a nominated representative of the relevant LPAs, and the local Wildlife Trust (or other similar body to be agreed).

Types of Reviews, Timings and Governance

6.2.43 The GGP has an established design and technical assurance framework, using a risk-based approach to support the scale and pace of design produced by the GGP. Alongside this, the DRP will provide a design review and design quality assessment overlay for key focus areas of the proposed infrastructure, and at key points in the detailed design development programme, to help National Grid continue in their obligation to meet Good Design outcomes.

6.2.44 The Design Review Panel will be invited to review and comment on those design matters set out in the Design Principles section of the DASSI. However, its role is advisory and it will not have the authority to determine the final design outcome alone, where the Design Review Panel Report will provide recommendations for change. Design matters will be considered collaboratively and in accordance with the design panel's agreed terms of reference. Responsibility for design decisions and the selection of preferred design solutions will rest with the Design Executive, who will have regard to the recommendations of the DRP and who will provide reporting and governance oversight in relation to those decisions. The Delivery and Detailed Design Champion will oversee this process in support of securing Good Design.

6.2.45 Using GGP's established design assurance model, DRP Design Reviews are proposed to be timed in accordance with the GGP's Design Control Points (DCPs). Should the Secretary of State be minded to consent the scheme, it is proposed that two types of Design Reviews are held and aligned to the DCPs as follows:

Image 6.2 Extract from GGP Design and Technical Assurance Process – Design Control Points / Target Design Reviews

DCP03	Detailed Design	The design stage is where the 'first-in-type' designs taken from the reference design library are adapted, scaled up and produced for all extents of the project's limits for full coverage.
DCP04	Final Design	The design includes sufficient allow detail allowing for the finalisation of material and equipment and manufacture or production of supply contracts (Tier 2) to be commenced.

DCP03 Detailed Design – Standard Design Review – DR1

6.2.46 At DCP03 Detailed Design stage the first DRP Design Reviews will be undertaken for each location type described in the Design Review Process. This will take the format of a Standard Review, whereby the project team presents the project to the panel, focussed on the Design Principles scope for variation as provided in the DASSI. This will give the Executive Design team the opportunity to make a case for their proposals, engage in discussion and hear the panel's comments directly.

6.2.47 This review will be held as a full-day or half-day meeting. The session will include a site visit, presentations on strategic and detailed issues, panel discussion and a chair summary of comments and advice.

DCP04 Final Design – Validation Design Review – DR2

6.2.48 At DCP04 Final Design stage is an opportunity for the DRP to undertake a validation Design Review. This will be a continuity and compliance check to ensure that recommendations from DCP03 Detailed Design stage / DR1 have been incorporated,

as far as practicable, into the final design. Validation Design Review will be undertaken for each location type described in the Design Review Process.

6.2.49 This will be undertaken in a workshop setting, whereby the project team presents a summary of changes incorporated from DR1 and to engage in discussion and hear the panel's comments directly.

6.2.50 This review will be held as a half-day meeting. The session will include a panel discussion and a chair summary of comments and advice.

DR1 and DR2 Output – Design Review Panel Report

6.2.51 The DRP will provide the project team with a brief report summarising the comments and advice. The report will be written by the DRP members and checked with the panel Chair. The reports are intended to be an articulate summary of DRP's advice pertaining to the design proposal, with particular focus on the elements and scope for change set out in the Design Principles of the DASSI.cThe report will cover the project's strategic challenges and opportunities as well as what is currently working successfully and advice as how to improve the areas that require further development.

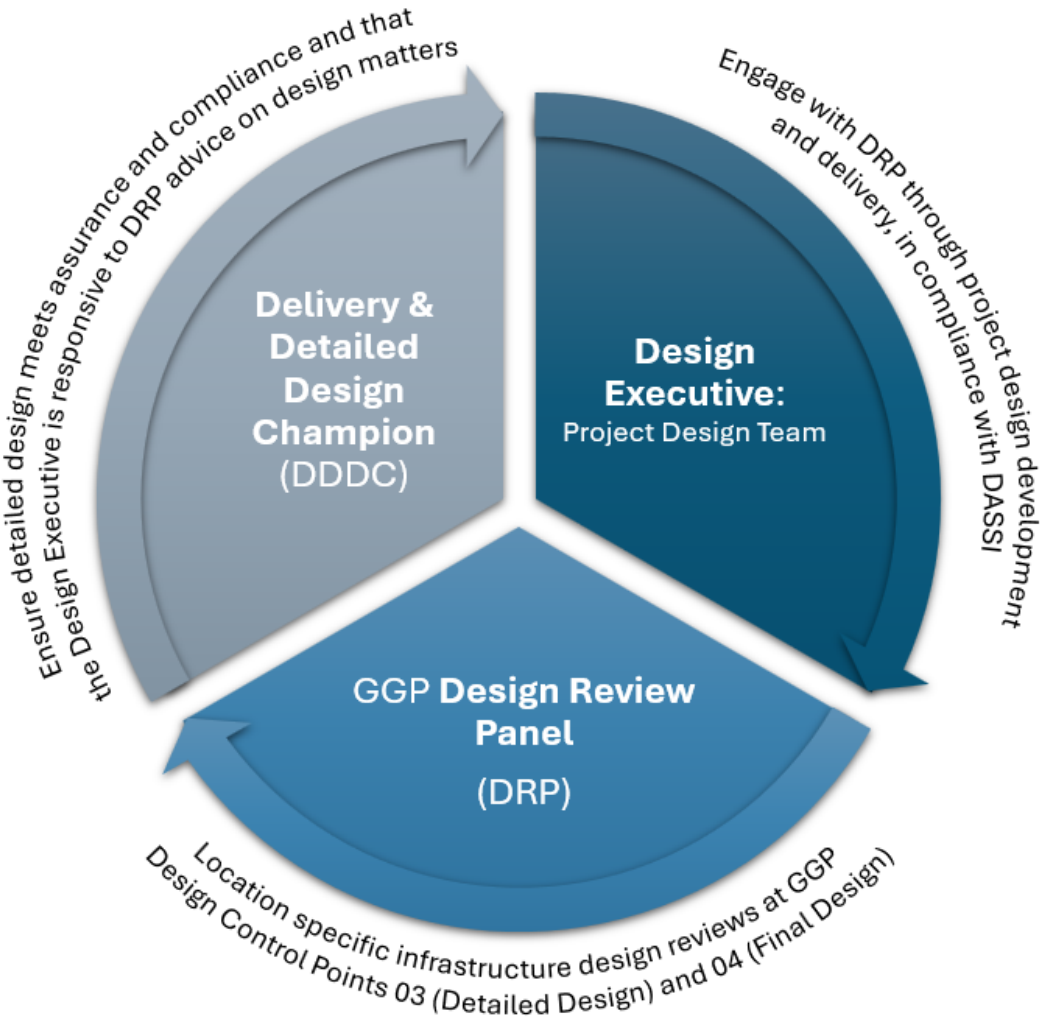
6.2.52 The DRP report will be issued in a timely manner and in alliance with GGP's design assurance process and programme.

6.2.53 Image 6.3 below illustrates the intended governance structure in support of securing Good Design, framed around the established and tried and tested GGP assurance process and programme.

6.2.54 The Detailed Design and Delivery Champion (DDDC) will not be part of the DRP but will ensure that the Design Executive have regard to the recommendations and advice from Design Review.

6.2.55 The timing and focus areas of Design Reviews will be programmed to maximise attendance of core panel members and identified local collaborators, with a two-staged Design Review process creating the opportunity for continued design improvement, value and optimisation in securing Good Design requirements.

Image 6.2 Tripartite governance approach and process to securing Good Design through post-consent and delivery, using Design Review Panel, Design Champion, and the Design Executive



Summary

6.2.56 In summary, the applicant considers that by adopting the DRP Design Review model in support of Good Design this will:

- Provide a uniquely tailored Design Review approach that focusses meaningful on-going design assessment to project infrastructure where the value of the process can be maximised.
- Deliver 'Informed Independence'. By being hosted by GGP and supported by a panel of experts relevant to the proposed infrastructure, it will capture the benefits of IDRPs.
- Enhance confidence in controlling the timing of DRP Design Reviews in relation to the DCO decision-making and project delivery

'Projects cannot rely on design champions and review panels alone. Everyone involved in designing national infrastructure - from designers and planners, to project managers and sponsors, should guide infrastructure design.'

National Infrastructure Commission

6.3 Approval Process

6.3.1 The DASSI document has been prepared as part of the development consent application submission. It will be shared with the relevant Local Planning Authorities for discussion and reviewed as part of the Statements of Common Ground (SoCGs). The DASSI document is intended to be a live and working document that will be updated as the examination progresses, as appropriate. The final SoCGs will be prepared ahead of the close of the DCO Examination and further comments on the DASSI will be addressed and updated accordingly.

6.3.2 The draft **3.1 Development Consent Order (DCO) [REP4-038]** is a critical mechanism for ensuring that good design is secured. It ensures that the design retains flexibility to respond to site conditions, innovation, and stakeholder feedback whilst embedding enforceable design commitments that provide clarity, certainty, and accountability. This section explains how the DCO ensures that the final built outcome secures the design aspirations assessed during examination and meets the expectations of stakeholders and the public.

6.3.3 Should the application for development consent be approved by the Secretary of State, Article 3 will give the legal authorisation for the development. Schedule 1 of the DCO will define the authorised development - the specific works and infrastructure that are granted development consent under the DCO. Schedule 1 lists individual work numbers which describe the key elements of the project, such as overhead transmission electric line and underground transmission electric line.

6.3.4 Whilst Schedule 1 defines the works, the **2.3 Works Plans [APP-017, APP-018, REP4-015, APP-020, APP-021, APP-022, APP023** and **REP4-016]** show the spatial location of those works and identify the limits of deviation of each work number listed in Schedule 1. The scope of the limits of deviation are defined in writing in article 5 of the DCO (limits of deviation). The Works Plans also include the table of parameters which state the maximum height and upward extent of vertical limits of deviation for permanent infrastructure.

6.3.5 Schedule 19 (certified plans) lists all the documents that are formally “certified” and become the definitive version of what the National Grid must follow. Other parts of the DCO, especially Schedule 3 (requirements), will refer to specific certified documents.

6.3.6 Schedule 3 of the DCO (Requirements) controls how the Project is built by securing conditional control relating to design. The requirements secure mitigation commitments from the ES, provide the mechanism for agreeing detailed design where necessary, provide legal certainty and compliance controls and provide practical controls for the construction and operation phase.

Requirement 4

6.3.7 Requirement 4 of the draft DCO relates to the construction management plans and requires the submission, approval and implementation of a suite of construction management plans. As part of this suite, some plans have already been developed into an outline format to deliver commitments made within the ES into a practical set of controls and procedures that the contactor must follow. The outline management plans already drafted are to be certified as part of the application and listed in Schedule 18 and final versions must be substantially in accordance with the outline.

6.3.8 The Outline LEMP is secured under Requirement 4, the final LEMPs must be substantially in accordance with the Outline LEMP and no stage of the authorised development may commence until, for that stage, the final LEMP has been submitted to and approved by the relevant planning authority, in consultation with Natural England.

Schedule 19 and Requirement 6

6.3.9 Requirement 6 set out that the authorised development will be carried out in general accordance with the elevations shown on the 2.6.1 Design and Layout Plans – Subs and Cables (Revision C). The following plans relate to the indicative 2.6.1 Design and Layout Plans – Subs and Cables (Revision C) of the permanent infrastructure discussed within this document and will be identified within Schedule 19 within the draft 3.1 DCO (Revision E) and certified:

Table 6.2 Open Space Assessment

Drawing Title	Drawing Number	Revision
Illustrative joint bay arrangement standard detail Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-06	A
Illustrative joint bay arrangement standard detail (combined link pillars) Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-06A	A
Indicative Bramford substation elevations Section B, Sheet 1 of 2	AENC-MMAC-ENG-DWG-0085-12	A
Indicative Bramford substation elevations Section B, Sheet 2 of 2	AENC-MMAC-ENG-DWG-0085-12	A
Indicative cable sealing end compound layout & elevations Wenham Grove Section C, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-13	A
Indicative EACN substation elevations Section C, Sheet 1 of 2	AENC-MMAC-ENG-DWG-0085-15	A
Indicative EACN substation elevations Section C, Sheet 2 of 2	AENC-MMAC-ENG-DWG-0085-15	A
Indicative cable sealing end compound layout & elevations Great Horkesley – EACN side Section D, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-16	B
Indicative cable sealing end compound layout & elevations Great Horkesley – Tilbury side Section D, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-17	B
Indicative cable sealing end compound layout & elevations Fairsted – EACN side Section E, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-18	B

Drawing Title	Drawing Number	Revision
Indicative cable sealing end compound layout & elevations Fairsted – Tilbury side Section E, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-19	B
Indicative Tilbury North substation elevations Section H, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-21	B
Indicative cable sealing end compound layout & elevations YYJ Turn in – Tilbury North (Warley side and Tilbury Side) Section H, Sheet 1 of 1	AENC-MMAC-ENG-DWG-0085-24	A

6.3.10 These plans present an indicative representation of CSE compounds and substations based upon the Project Description as set out in Chapter 4 of the **ES [APP-130]**.

6.3.11 Requirement 6 requires the authorised development to be carried out in general accordance with the Design and Layout Plans (elevations) that have been certified under Schedule 19 of the draft DCO. This includes the levels shown on the plans. The authorised development will be in general accordance with the design and layout plans to the extent that any departure from the design and layout drawings shall not give rise to any materially new or materially different environmental effects from those assessed in the ES.

Requirement 11

6.3.12 The requirement recognises that whilst there is generally very limited flexibility regarding scale, layout and appearance of substations and CSE compounds given their technical restrictions, as set out in this document, the proposed Tilbury North GIS substation does offer more flexibility regarding the final colour finish than other substation sites.

6.3.13 This requirement requires the relevant local planning authority to agree the final colour of the GIS building and gas insulated hall annex, at the Tilbury North Substation site to ensure visual cohesion.

Requirement 12

6.3.14 This requirement ensures that the final appearance of permanent buildings is consistent with the approved design principles in this document, which will be certified under Schedule 18. It provides a mechanism for enforceable design-led detailing post consent, ensuring matters agreed during examination are delivered throughout construction whilst still allowing flexibility for innovation at detailed design stage.

6.3.15 The other relevant requirements within the draft 3.1 DCO (Revision E) are:

- Requirement 8 - Retention and removal of trees, woodland and hedgerows. This requirement ensures that the detailed design phase of the project reflects the certified “trees and hedgerows to be removed or managed” plans (reference 2.16), maintaining alignment with what was assessed in the ES. This requirement prevents the premature or excessive clearance of trees, woodland and

hedgerows by requiring submission of these finalised plans prior to commencement of development. This requirement also ensures that the removal of trees, woodland and hedgerows is carried out in accordance with measures captured within the Landscape and Ecological Management Plan (LEMP), a final version of which will be agreed prior to commencement of development under requirement 4 (construction management plans).

- Requirement 9 – Reinstatement planting plans - This requirement ensures that the reinstatement planting design following construction activities includes appropriate restoration of temporarily disturbed areas in a way that is consistent with the approved LEMP.

Abbreviations

Abbreviation	Full Reference
AEP	Annual Exceedance Probability
AIS	Air Insulated Switchgear
AOD	Above Ordnance Datum
AONB	Area of Outstanding Natural Beauty
BNG	Biodiversity Net Gain
CoCP	Code of Construction Practice
CSE	Cable Sealing End
DAS	Design and Access Statement
DASSI	Design Approach to Site Specific Infrastructure
DCO	Development Consent Order
DDR	Design Development Report
DRC	Dynamic Reactive Compensator
EACN	East Anglia Connection Node
ES	Environmental Statement
EV	Electric Vehicle
FLT	Full Line Tension
GIB	Gas Insulated Busbar
GIS	Gas Insulated Switchgear
GRP	Glass Reinforced Plastic
Km	Kilometre
kV	Kilovolt
LCA	Landscape Character Area
LED	Light-emitting diode
LEMP	Landscape and Ecological Management Plan
LoD	Limits of Deviation
LTC	Lower Thames Crossing
LVAC	Low Voltage Alternating Current
NETS SQSS	National Electricity Transmission System Security and Quality of Supply Standard

Abbreviation	Full Reference
NPS	National Policy Statement
PAR	Primary Access Route
The Project	Norwich to Tilbury
PRoW	Public Right of Way
SCADA RTU	Supervisory Control and Data Acquisition Remote Terminal Unit
UK	United Kingdom
UKPN	UK Power Networks

Glossary

Term	Description
Abnormal Indivisible Loads	A large load which cannot 'without undue expense or risk of damage' be divided into two or more smaller loads for the purposes of being transported by road, and which exceeds limits set out in terms of weight (>44 tonnes), length (>18.65 m), and width (>2.9 m).
Alignment	The proposed overhead line and underground cable route.
Ancient woodland	Land that has been continually wooded since at least 1600 in England. Regarded as 'irreplaceable habitat' in national planning policy and guidance. Ancient woodland greater than 2 ha is recorded on the Natural England Ancient Woodland Inventory.
Bellmouth	A flared vehicular access point connecting a construction site to the public highway, designed to accommodate turning movements by large vehicles.
Biodiversity	The variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species and of ecosystems.
Biodiversity Net Gain	An approach for developments to ensure habitats for wildlife are left in a measurably better state than they were before the development.
Circuit	A set of wires along which current flows and returns. It is necessary to have a complete circuit for current to flow. The National Grid standard for overhead lines operating at 400 kV is for pylons to carry two circuits, each consisting of three phases, i.e. a double circuit configuration.
Cable	An insulated conductor designed for underground installation.
Cable Sealing End	Structures used to transfer transmission circuits between underground cables and overhead lines.
Cable Sealing End compound	Electrical infrastructure used as the transition point between overhead lines and underground cables. A compound on the ground acts as the principal transition point.
Code of Construction Practice	A code of construction practice sets out the standards and procedures to which a developer (and its contractors) must adhere in order to manage the potential effects of construction works.
Conductor	The overhead wire that carries electricity from one place to another, for example the line between two pylons.
Design Approach for Site-Specific Infrastructure	Document developed by National Grid to outline the design principles that can be taken forward into the detailed design, set out an approach to the design of site-specific infrastructure of non-linear works, and to detail those elements of the design which have some flexibility in their appearance.

Term	Description
Development Consent Order	A statutory instrument which grants consents and other rights to build a Nationally Significant Infrastructure Project, as defined by the Planning Act 2008.
Distribution Network Operator	Companies that own and operate the power lines and infrastructure that connect the National Grid network to individual properties.
Embedded design measures	Mitigation measures are those that are intrinsic to and built into the design of the Project.
Environmental Statement (ES)	The main output from the EIA process, an ES is the report required to accompany an application for development consent (under the Infrastructure Planning (EIA) Regulations 2017) to inform public and stakeholder consultation and the decision on whether a project should be allowed to proceed. The EIA Regulations set out specific requirements for the contents of an ES for Nationally Significant Infrastructure Projects.
Flood Risk Assessment	A Flood Risk Assessment is an assessment of the risk of flooding, particularly in relation to residential, commercial and industrial land use. In England and Wales, the Environment Agency requires a Flood Risk Assessment to be submitted alongside planning applications in areas that are known to be at risk of flooding.
Full line tension gantries	Types of gantries which allow conductors to connect into a substation or compound directly from a pylon, without requiring a bulky terminal pylon. This allows a larger span between the final pylon and the gantry.
Gantry	An overhead bridge-like structure supporting electrical equipment. A transition point from overhead line equipment to equipment in a compound.
Greenhouse gases	The term ‘greenhouse gases’ refers to a number of chemicals in the earth’s atmosphere such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O).
Heavy Goods Vehicles	Goods vehicles weighing more than 3,500 kg.
High voltage	275,000 volts and over. National Grid’s transmission lines generally operate at 275,000 and 400,000 volts. Lower voltage lines, such as 132,000 volts and 33,000 volts, are generally owned by local distribution companies.
Insulator	Used to attach the conductors to the pylons, preventing electrical discharge to the steelwork.
Kilovolt	1,000 volts
Landscape character	A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another, rather than better or worse.
Lattice pylon	Pylon type widely used on the national electricity transmission networks. Both standard lattice pylons (approximately 50 m in height)

Term	Description
	and low hight lattice pylons (approximately 40 m in height) are proposed on the Project.
Limits of Deviation (LoD)	LoD allow for adjustment to the final positioning of the permanent features, for example to avoid localised constraints or unknown or unforeseeable issues that may arise. This could include previously unidentified poor ground conditions which require a pylon to be moved slightly for geotechnical reasons, such as ground stability. The horizontal LoD define the parameters within which the position on the ground of proposed permanent features may deviate from the position shown on the plans. This applies to both linear (for example overhead lines and underground cables) and non-linear (for example the new EACN Substation and CSE compounds) proposed infrastructure. Vertical LoD limit the maximum vertical height, or the depth below ground, of any new infrastructure.
Local Planning Authority	The public authority whose duty it is to carry out specific planning functions for a particular area.
Mitigation	The action of reducing the severity and magnitude of change (impact) to the environment. Measures to avoid, reduce, remedy or compensate for significant adverse effects.
National Landscape (an Area of Outstanding Natural Beauty)	Formally designated under the National Parks and Access to the Countryside Act of 1949 to protect areas of the countryside of high scenic quality that cannot be selected for National Park status due to their lack of opportunities for outdoor recreation (an essential objective of National Parks). As of November 2023, all AONBs became 'National Landscapes'. This reflects ambitions for the areas to play a key part in the international '30 by 30' commitment (to protect and conserve a minimum of 30% of land and sea for biodiversity by 2030).
Nationally Significant Infrastructure Project	Typically a large-scale development of national importance that requires development consent from the Secretary of State, under the Planning Act 2008.
Order Limits	The maximum extent of land within which the authorised development may take place.
Overhead line	Conductor (wire) carrying electric current, strung from pylon to pylon.
Permanent access	Access required to infrastructure during the operational phase of the Project, for operational and maintenance purposes.
Project Section	Geographical 'sections' have been identified that break the Project down into smaller units for ease of description within the documentation. These Project Sections are broken down into eight sections based largely on Local Planning Authority boundaries.
Public Right of Way (PRoW)	A footpath, bridleway or byway accessible to all members of the public.
Pylon	Structures that support the overhead line (conductors).
Scoping Report	Report determining the content and extent of matters that should be covered in the Environmental Impact Assessment.

Term	Description
Substation	Substations are used to control the flow of power through the electricity system. They are also used to change (or transform) the voltage from a higher to lower voltage to allow it to be transmitted to local homes and businesses.
Terminal pylon	Pylons erected at the end of the overhead line to terminate the line at substations or where overhead lines are connected to underground cables. Because of the uneven load on one side of the pylons, much deeper and heavier foundations are required on the unloaded side.
Transmission line	A National Grid overhead line and underground cable which transmits electricity between National Grid's substations. Power is transmitted at high voltages (275 kV or above) between power stations where it is generated and the local electricity supply networks of the regional Distribution Network Operators where it is transformed to lower voltages (132 kV or below) for supply via distribution lines to local communities.
Temporary construction compounds	Temporary compounds installed during the construction phase of the Project. Each compound may contain storage areas including laydown areas, soils storage and areas for equipment and fuel, drainage, generators, car parking and offices and welfare areas (portacabins).
Underground cable	An insulated conductor carrying electric current designed for underground installation. Underground cables link together two Cable Sealing End compounds.
Voltage	The electrical potential difference between two points.

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Appendix A. Guide to the Approach on Design

nationalgrid

Guide to the approach on design

This Guide to the approach on design includes the key documents that form the project's design approach.

While there is no statutory requirement to produce design-related documents, paragraph 4.7.7 of EN-1 (2024) states that:

"Applicants must demonstrate in their application documents how the design process was conducted and how the proposed design evolved. Where a number of different designs were considered, applicants should set out the reasons why the favored choice has been selected."

This is not the interactive version of the Guide to the approach on design.

To view the interactive version of this guide please visit https://www.nationalgrid.com/electricity-transmission/network-and-infrastructure/infrastructure-projects/norwich-to-tilbury/document-library

Advice issued by the Planning Inspectorate also states that the applicant can submit any document that could help assist in meeting requirements of a National Policy Statement including a design and access statement among other supporting design documents.

Given the linear nature of the proposed electricity transmission project that comprises various components, the following documents have been prepared to capture the design process:

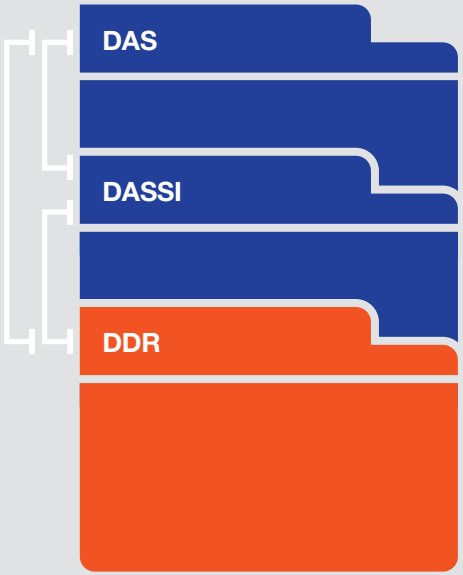
- **DAS –** Design and Access Statement (document reference 7.15)
- **DASSI –** Design Approach Site Specific Infrastructure (document reference 7.16)
- **DDR –** Design Development Report (document reference 5.15)

As you move to the main page of each design document by clicking on the centralised interactive folder to each report, the purpose behind the document and interactions between each report is explained.

The interactive folder therefore provides a central repository to help those interested in understanding where to find key information on design and linkages to other documents that have helped shape and inform the design approach. Access to each design related document and the contents of the report is set out to assist those wanting to access and understand more about the way in which the project design addresses the policy, advice note requirements, regulatory and statutory duties.

Guide to the approach on design

Document



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To explore one of our DCO documents, relating to design click on a folder. To return to the home screen, please click the home icon, top right.

We've produced this interactive PDF to show the design documents that underpin our design approach.

Click on one of the folders on the left to view the document, read a summary and find out more information on our design approach.

Guide to the approach on design

Document

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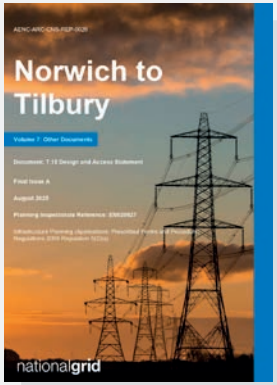
Summary

The Design and Access Statement (DAS) describes the factors that influence design in relation to the permanent linear elements of the Project. The DAS sets out the background to the Project, the design principles applied by National Grid and summarises the approach to and development of good design. It also provides details on the permanent access for both the substations and Cable Sealing End Compounds.

The DAS provides an evaluation and review of the Good Design Process summarising how the design and location have been informed by the Design Principles with reference to the 'Planning Inspectorates Nationally Significant Infrastructure Projects: Advice on Good Design' and the National Infrastructure 'Commission Design Guidance'. It also includes an Internal Design Review Note.

The report acts as the 'central' design Document that links closely with the DDR and DASSI.

Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Overview of the Project
- **Chapter 3** – Legislation, Policy and Guidance Context
- **Chapter 4** – Physical Context
- **Chapter 5** – Good Design Process
- **Chapter 6** – Conclusions

Guide to the approach on design

Document

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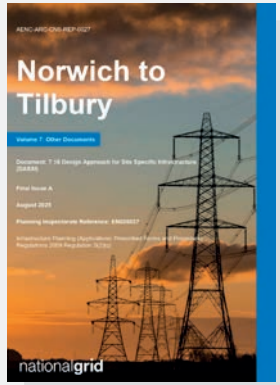
Summary

The Design Approach to Site Specific Infrastructure (DASSI) relates to the details of the site specific infrastructure of the nonlinear works included in the Project, such as the substations and Cable Sealing End Compounds (CSEC's).

This document outlines the design principles that can be taken forward into the detailed design stage, sets out an approach to the design of site specific infrastructure of non-linear works, and details those elements of the design which have some flexibility in their appearance. The document links closely with the DAS and DDR. The DASSI differs from the DDR in that it provides site specific details for non-linear infrastructure.

The document is closely linked with the 'detailed design' Requirement in the draft Development Consent Order (dDCO) and is a "certified" document under Schedule 18.

Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Site Location and Context
- **Chapter 3** – Examples of Existing Infrastructure
- **Chapter 4** – DCO Design and Operational Function
- **Chapter 5** – Design Principles and Scope for Variation in Developing the Detailed Design
- **Chapter 6** – Approach to Detailed Design and Approval Process

Guide to the approach on design

Document

If you wish to view previous versions of the DDR or a copy of the Consultation Report you can view them in the documents section of the **Planning Inspectorate's website**.

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Summary

The Design Development Report (DDR) provides an overview of the main changes in route alignment, infrastructure siting, and technology for the Norwich to Tilbury Project, based on feedback from the 2024 statutory consultation and targeted consultations in 2025.

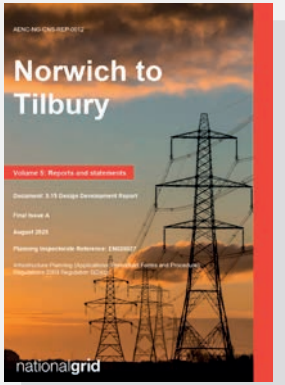
This report highlights the key changes requested in feedback received from consultations, taking into account various factors to ensure balanced decision-making.

It is important to note that the DDR does not encompass all changes, particularly smaller adjustments such as minor pylon relocations, which are addressed in the Consultation Report.

The DDR details the changes being sought, outlines the National Grid's responses, and explains the rationale behind decisions to either proceed with or forgo specific changes.

The DDR provides the details on the linear route and siting with close links to the Consultation Report.

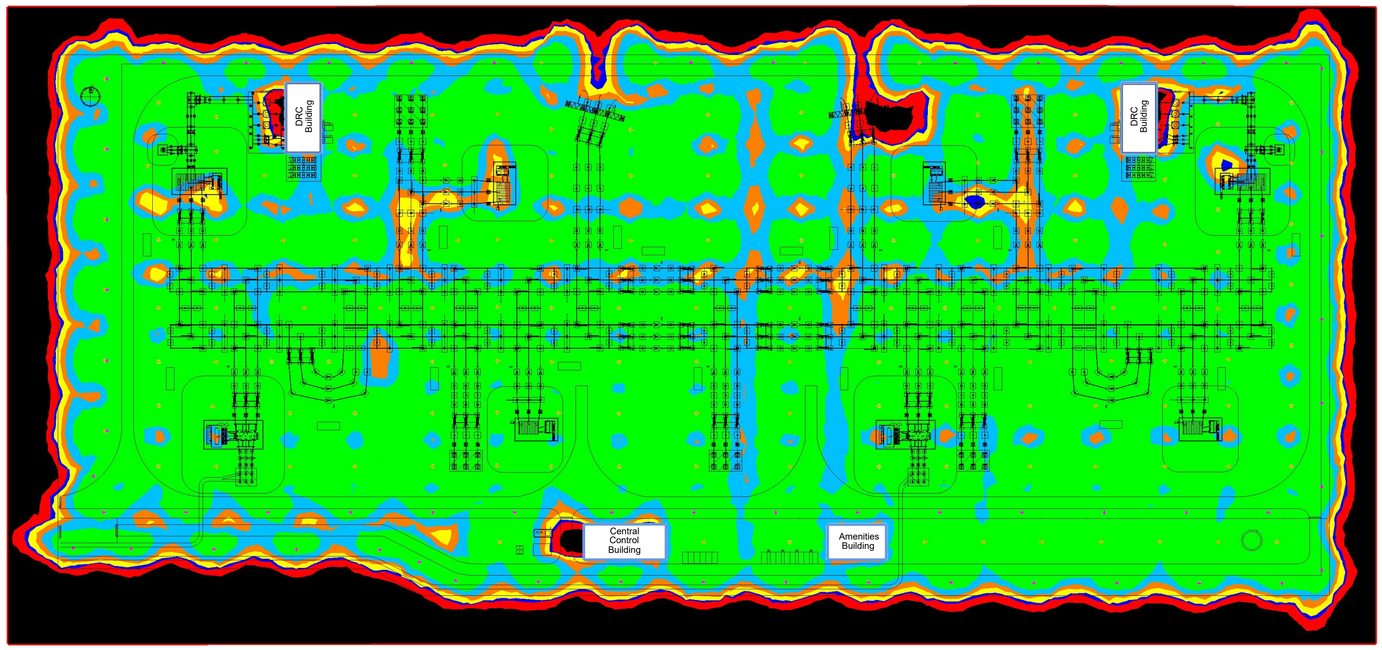
Overview



The report is structured as follows:

- **Chapter 1** – Introduction
- **Chapter 2** – Project wide considerations relevant to the design development
- **Chapter 3** – Overview and Summary of Changes Taken Forwards
- **Chapter 4** – Section A South Norfolk
- **Chapter 5** – Section B Suffolk
- **Chapter 6** – Section C Babergh and Tendring
- **Chapter 7** – Section D Colchester
- **Chapter 8** – Section E Braintree
- **Chapter 9** – Section F Chelmsford
- **Chapter 10** – Section G Brentwood and Basildon

Appendix B. Indicative Lux Plot Plans



Notes

1. Do not scale from this drawing.
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3. This drawing is to be read in conjunction with all relevant documents and drawings.
4. No unauthorised disclosure, storage or copying.
5. All spatial coordinates relate to the Ordnance Survey, British National Grid (OSGB36).
6. All levels are in meters and relate to AOD (Ordnance Survey, Newlyn).
7. Shall be in accordance with the recommendations of National Grid TS 2.10.04.

Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

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Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	EACN SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

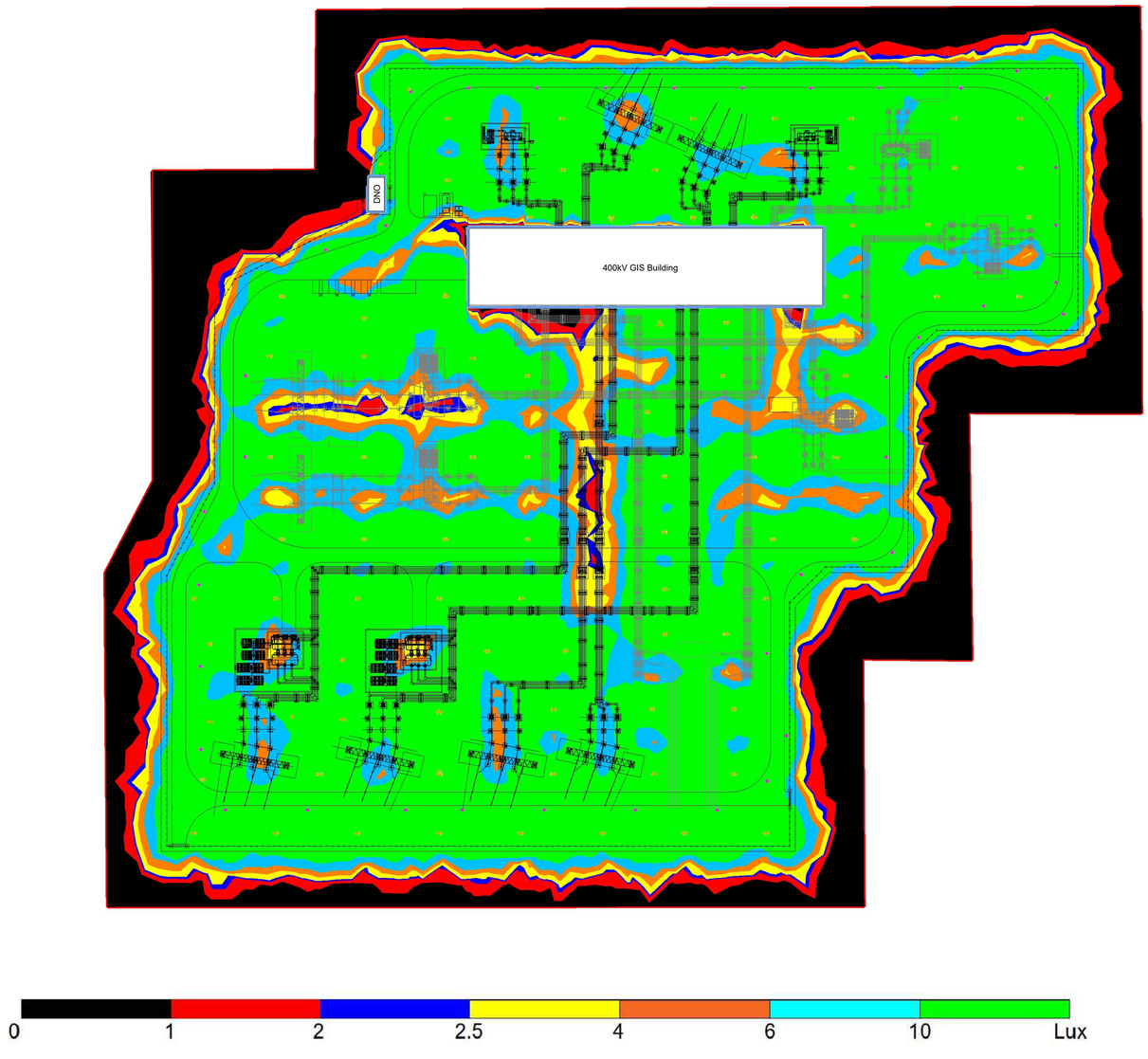
7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – EACN SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
T. Loxley	PDF	NTS	PDF	01 of 01	01

National Grid Document Number: AENC-ARC-CNS-REP-0027-01

FEED Document Number: AENC-ARC-CNS-REP-0027-01



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7. Shall be in accordance with the recommendations of National Grid TS 2.10.04.

Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	TILBURY NORTH SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

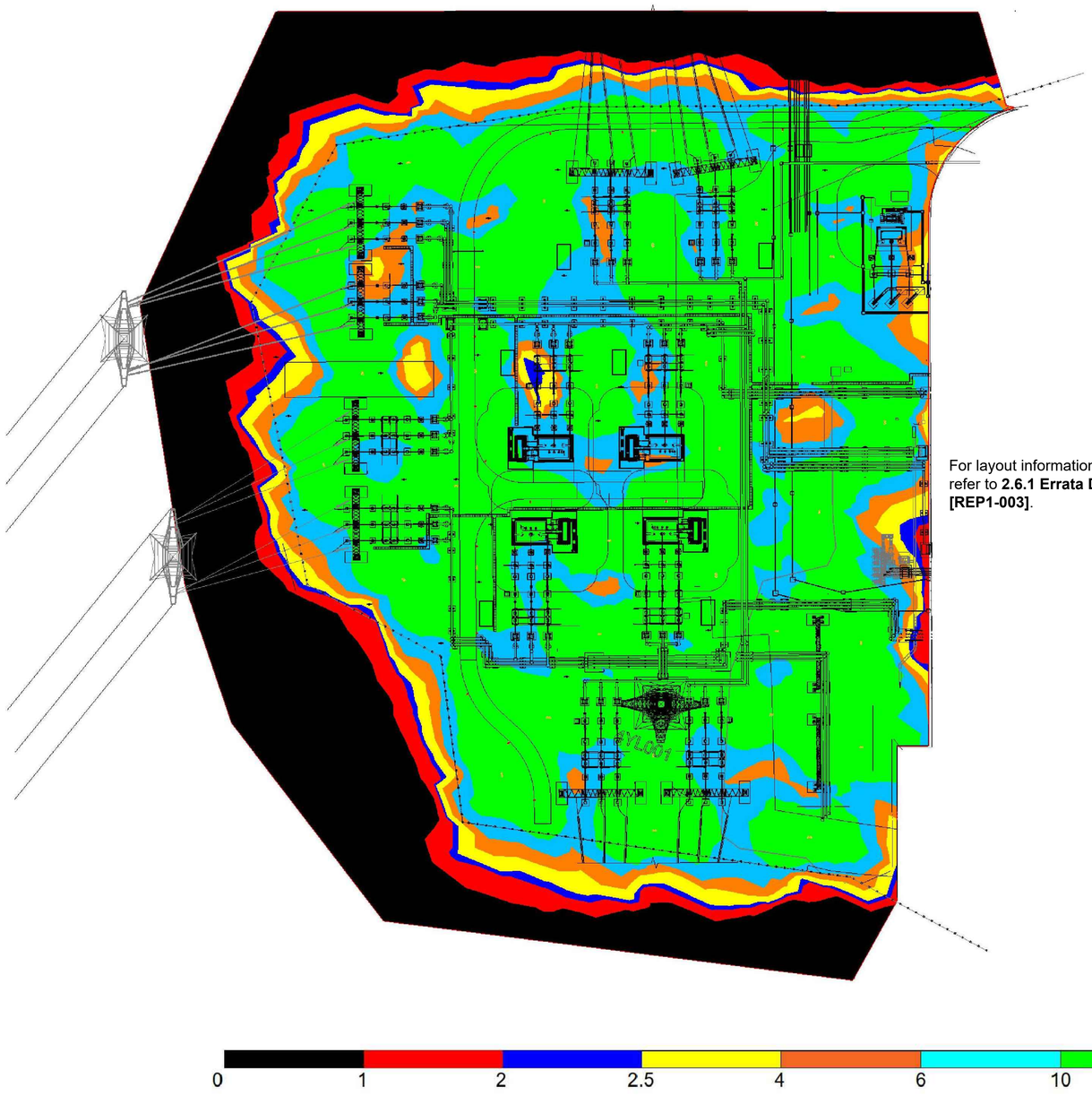
7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – TILBURY NORTH SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
T. Loxley	PDF	NTS	PDF	01 of 01	01

National Grid Document Number: AENC-ARC-CNS-REP-0027-02

FEED Document Number: AENC-ARC-CNS-REP-0027-02



For layout information with regards to the existing Bramford Substation please refer to **2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]**.

Notes

1. Do not scale from this drawing.
2. All dimensions are in metres/millimetres unless otherwise stated.
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7. Shall be in accordance with the recommendations of National Grid TS 2.10.04.

Key to symbols

Reference drawings

2.6.1 Errata Design and Layout Plans - Subs and Cables [REP1-003]

Rev	Date	Drawn	Description	Ch'k'd	App'd
01	MAY 26	TM	FOR INFORMATION	JW	TL

Client

nationalgrid

Master Scheme No:	Sub-Scheme No:	Site:
107850	001190	BRAMFORD SUBSTATION

Scheme Name: NORWICH TO TILBURY

Document Title:

7.16 DESIGN APPROACH FOR SITE SPECIFIC INFRASTRUCTURE (DASSI) APPENDIX B – BRAMFORD SUBSTATION INDICATIVE LUX PLOT PLAN

Created by:	Date:	Checked by:	Date:	Approved by:	Date:
T. McDermott	MAY 26	J. Weeks	MAY 26	T. Loxley	MAY 26

Development Eng:	Document Type:	Scale:	Format:	Sheet(s):	Rev:
T. Loxley	PDF	NTS	PDF	01 of 01	01

National Grid Document Number: AENC-ARC-CNS-REP-0027-03

FEED Document Number: AENC-ARC-CNS-REP-0027-03

Appendix C. GGP Design Governance Delivery and Detailed Design

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Appendix C
GGP Design Governance Delivery and Detailed Design

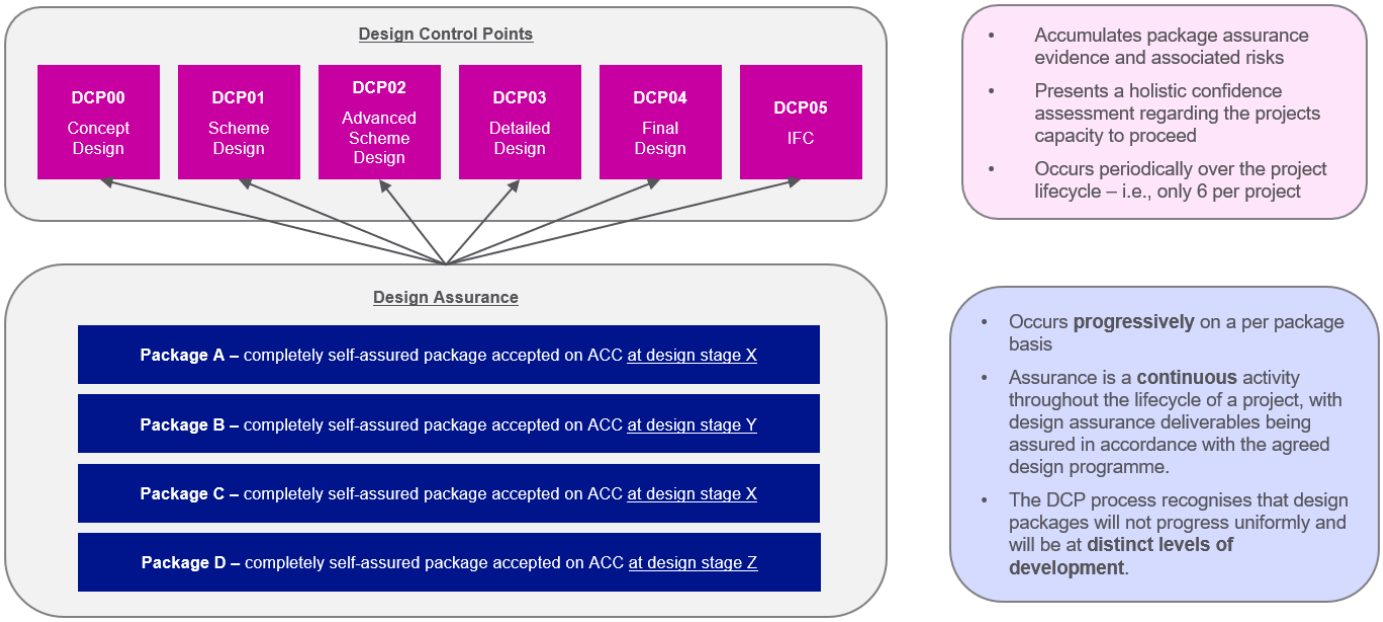
C.1 Purpose

The GGP technical assurance approach forms part of the broader Strategic Infrastructure (Onshore) design governance captured under the Strategic Infrastructure Management System (SIMS).

The technical assurance process for GGP is formed of two **distinct** levels:

- **Design Package Assurance**: The process where an authorised engineer reviews and accepts engineering deliverables to ensure that design meets the requirements of the scope, is technically sound and compliant with all relevant specifications.
- **Design Control Points (DCPs)**: These are holistic project-level assessments conducted at key stages of development to assess overall engineering confidence. It consolidates all design assurance evidence, reviews project-level design risks and serves as a formal design point to confirm that the project is ready to advance to the next stage of development.

This arrangement is depicted diagrammatically below:



C.2 Design Lifecycle

The basic premise of the GGP design governance approach is one of design development and integration through controlled stages.

In support of the GGP Delivery Model, we have developed a **Design Control Framework** that promotes design integration and development through controlled stages. It provides an end-to-end framework that guides the design development process in a standardised way, bringing the whole design together at each control point. It provides oversight of the end-to-end process and synchronises all programme functions against as baselined design. This common framework will

support the enterprise partners ability to generate assurance evidence and present consistently at hold points, providing confidence the design is integrated, compliant and operable.

C.3 Design Control Points

The Design Control Point (DCP) is a holistic project-level assessment conducted at key stages of development to assess overall engineering confidence. It consolidates all assurance evidence, reviews project-level design risks and serves as a formal decision point to confirm that the project is ready to advance to the next stage of design development. There are six (6) DCPs that will occur throughout the lifecycle of the project, (see below for further details on each DCP).

DCP No.	Design Stage	Level of Design Confidence
DCP00	Concept Design	A single option has been selected, and the design concept is technically feasible and deliverable under the funding envelope and is compliant with Client requirements.
DCP01	Scheme Design	This stage applies the concept design to the geography and technical characteristics of the corridor ensuring that all interfaces with other parties can be achieved in the environment.
DCP02	Advanced Scheme Design	Scheme design has been applied to the specifics of the terrain and geography. There is an emphasis on clear interfacing design between the temporary and permanent works.
DCP03	Detailed Design	The design stage is where the 'first-in-type' designs taken from the reference design library are adapted, scaled up and produced for all extents of the project's limits for full coverage.
DCP04	Final Design	The design includes sufficient allow detail allowing for the finalisation of material and equipment and manufacture or production of supply contracts (Tier 2) to be commenced.
DCP05	Issued for Construction	This stage involves finalising and packaging the design to ensure it is complete, with all major assumptions validated and risks at a tolerable level. The design is reviewed for maturity and readiness before being issued to the Construction Partner as IFC documentation.

At each design control point, each functional entity is invited to provide positive confirmation that their functional requirements (including performance) and interfaces have been fully satisfied with an acceptable risk exposure (for the given stage of design maturity). These functions include[8]:

1. Environment and Sustainability
2. Land, planning and external affairs
3. Surveys (intrusive and non-intrusive)
4. Construction partner advice and comments

[8] The type, number and overall mix of functions will vary depending on design stage and project specifics.

5. Operations and maintenance
6. Third party dependencies

The typical assessment criteria for each DCP are shown in the figure below[9].

Assessment Criteria	Critical
Requirements & Scope	
Requirements baseline approved and traceable	Yes
Scope clearly defined, including exclusions	Yes
Standards & Compliance	
Alignment to codes, standards and legislation	Yes
Safety case (SFAIRP and ESQCR)	Yes
Consents and licenses embedded in the design	Yes
Non-conformances tracked and accepted	Yes
Validation approach / acceptance criteria for each requirement defined	No
Design Confidence & Quality	
Design assurance deliverables complete to maturity target	No
Peer reviews and verification complete	Yes
Evidence of internal self-assurance checking comments closed out	Yes
Maintainability / Operability review signed off	No
Configuration Status Report aligned with design	Yes
Interfaces & Integration	
Interface register up to date	No
Interdisciplinary reviews held	No
Integration risks mitigated	No
Clash detection / interface coordination captured in the CDE	No
Third parties coordinated functionally and spatially	Yes
Third party assurance approvals in place	Yes
Positive engagement with functions/disciplines	Yes
Risk & Hazard Management	
Design risk register up to date	Yes
Residual risks documented, transferred and accepted	Yes
Residual risk notes embedded in the drawing and BIM models (e.g., warning triangles)	No
Safety in design principles demonstrated	No

[9] The term 'critical' denotes an obligatory 'red' confidence assessment (at the DCP) for any major findings against these assessment criteria.

Assessment Criteria	Critical
Risk mitigations clearly traceable to requirements or design	No
Schedule & Cost	
Estimate class maturity developed (and aligned with design)	No
Programme class maturity developed (and aligned with design)	No
Risk class maturity developed (and aligned with design)	No
Long lead items identified	No

C.4 Design Governance: Framework Architecture

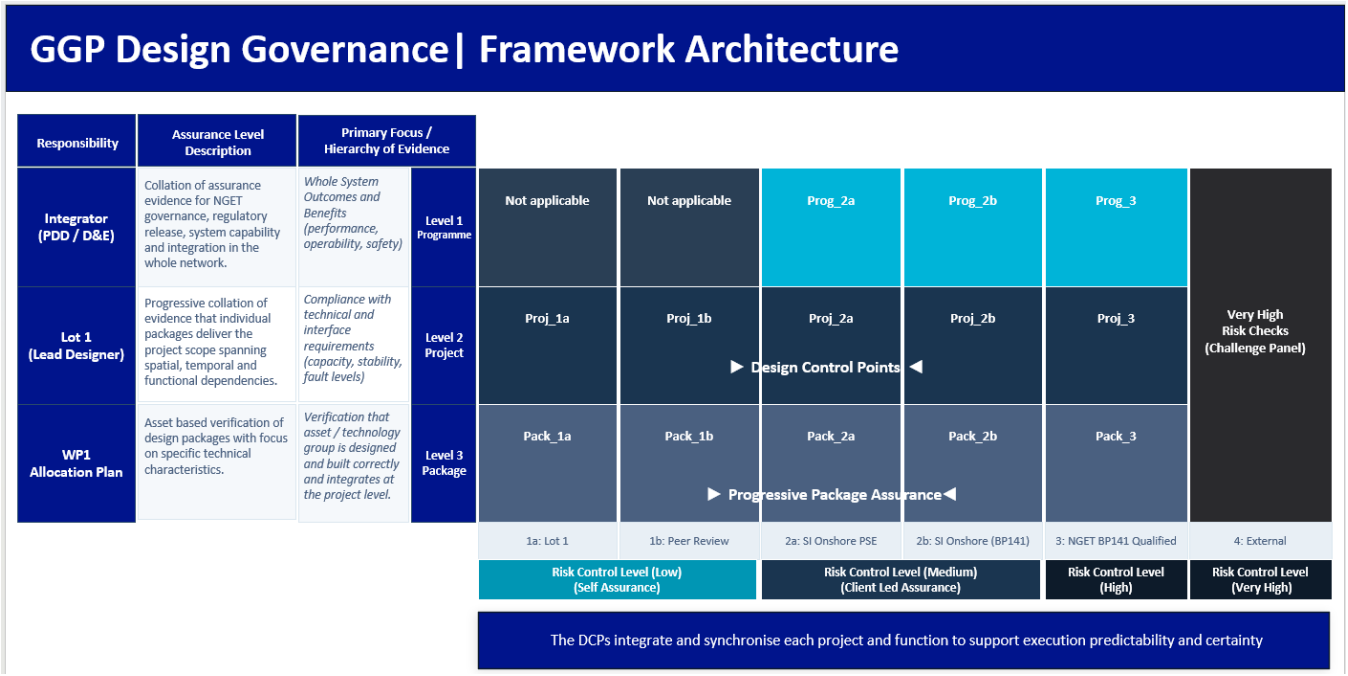
Within the GGP technical assurance model and designed to support the scale and pace of design produced by the GGP, a risk-based approach to design assurance has been implemented. One of six pre-determined risk control levels (RCLs) are to be assigned to each design package, based on the assessed level of risk.

Each RCL drives the level of reviewing intensity with higher RCLs attracting increased independent oversight and review. More specifically, the RCL determines which parties are required to provide review for each design package, broadly following a partner-led or client-led review pathway.

In support of the GGP Delivery Model, a proportionate, risk-based assurance framework has been developed that defines Risk Control Levels across the package, project, and programme tiers. Each level of the architecture has a distinct focus; the package level on technical compliance, at the project level on integration and delivery risk, and at the programme level on **systemic risk and assurance of strategic outcomes**. These sixteen options allow GGP to assess the programme from a range viewpoints depending on the emerging risk picture and thematic topics of concern.

In addition to the RCL and DCPs, it is incumbent on the lead designers (Design, Consenting and Environmental Partners) to provide a design management methodology that promotes a right-first-time approach to design delivery. These requirements are captured in GGP specifications, principally the DCP technical assurance specification, to include (not exhaustive):

1. Organisation structure.
2. Accountability and competence.
3. Self-assurance checking independence.
4. Safe/Secure-by-design practices.
5. Management and assurance of interdisciplinary design production.



The risk control level 4 (four) is reserved for **independent 'design challenge'** on specific strategic, technical or analytical aspects of the programme. It is matters that attract regulatory, legal and strategic technical risk (i.e. highest consequence design decisions) that would be subjected to these stress-test and challenge[10].

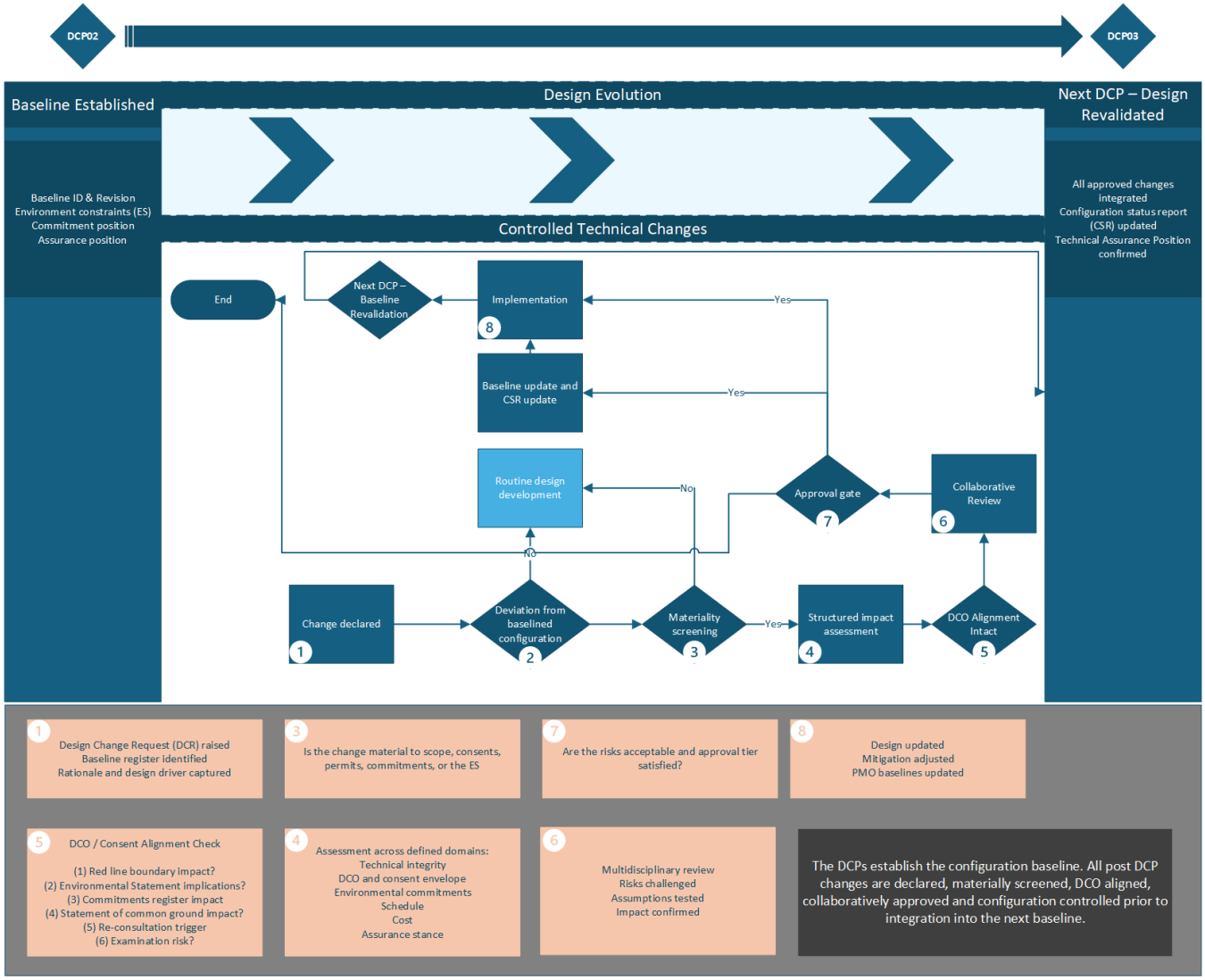
C.5 Configuration Control

An important aspect of the Design Control Points (DCP) will be the verification against the declared **technical baselines** that are struck at key points known as **configuration control**. The Configuration Status Report (CSR) serves as the definitive record of change control over the design lifecycle of the project. It captures the configuration status of all design deliverables at each stage documenting the approved configuration and the rationale for every change between each design stage to ensure disciplines traceability. The design is re-baselined at each DCP, creating a documented record of variance between the previous and current design stage, including both approved and unapproved design changes. Each iteration of the CSR builds on the previous stage to demonstrate version history and maturity progression.

In line with best practice, the design governance approach promotes the **continuity of the design intent** throughout the lifecycle. This will capture all 'certified plan's', including environment commitments, actions and obligations, enshrined with any consenting or planning act such that mandatory design requirements can be traced and routinely verified for ongoing compliance. All this seeks to minimize the risk of **design drift** and late-stage design shocks.

[10] The authority, composition, independence and terms of reference are under review.

This concept is illustrated in the figure below (indicative only):



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