YG-DCO-110(B)

Yorkshire Green Energy Enablement (GREEN) Project

Volume 8

Document 8.18(B) Design Approach to Site Specific Infrastructure (Tracked)

Final Issue ~~A~~B
~~April~~July 2023

Planning Inspectorate Reference: EN020024

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

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Contents

Document control

Version History			
Document	**Version**	**Status**	**Description / Changes**
26/4/2023	A	Final	First Issue
11/07/2023	B	Final	Second Issue

1. Introduction

1.1 Purpose of this Document

1.1.1 This Design Approach to Site Specific Infrastructure document has been prepared in support of the application for Development Consent for the Yorkshire Green Energy Enablement (GREEN) Project (referred to as the Project or Yorkshire GREEN). This document aims to supplement the Yorkshire GREEN **Design and Access Statement (DAS) (Document 7.2) [APP-203].** Whilst the DAS should be the primary document referred to for information on National Grid's approach to good design, as well as the design evolution of the overall project, this Design Approach document aims to focus on the site-specific infrastructure (non-linear works) within the named locations listed below.

1.1.2 The primary purpose of this document is 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. This Design Approach to Site Specific Infrastructure document relates to the details of the site specific infrastructure of non-linear works included in the Project, namely

- The proposed new Overton Substation (in Section B of the Project);
- The proposed new Monk Fryston Substation adjacent to the existing Monk Fryston Substation (in Section F of the Project);
- The proposed works at Osbaldwick Substation (in Section A of the Project);
- The two proposed new Cable Sealing End Compounds (CSEC's) at Shipton (Shipton North CSEC and Shipton South CSEC) (in Section B of the Project); and the two proposed new CSEC's at Tadcaster (Tadcaster East CSEC and Tadcaster West CSEC) (in Section D of the Project).

1.2 Structure of the Document

1.2.1 The Design Approach to Site Specific Infrastructure document has been structured to include the following sections:

- Section 1.0: Introduction – Outlines the purpose of this document, background to the project and design context.
- Section 2.0: Site Location and Context – Figures and descriptions of the sites involved in the project and relevant site-specific information.
- Section 3.0: Examples of Existing Infrastructure – Images showing existing substations and cable sealing end compounds to highlight variation in design.
- Section 4.0: DCO Design, Operational Function, Design Principles and Scope for Variation – Explanation of the components included in the design and their operational purpose, design principles and elements of scope that are variable and those that are not.

- Section 5.0: Approach to Detailed Design – Details of design where there is scope for variation in detailed design.

1.3 Background to the Project

1.3.1 The Project is sited within Yorkshire, with the most northerly components located approximately 1.5km north-east of the village of Shipton-by-Beningbrough and approximately 10km north-west of York city centre. The most southerly components are at the existing Monk Fryston Substation, located to the east of the A1 and immediately south of the A63.

1.3.2 The Project is divided into six sections for ease of reference as indicated in **Figure 1.2, of the Environmental Statement (ES) Chapter 1 Introduction Figures (Document 5.4.1) [APP-162].** In summary, the Project comprises the following new infrastructure within the Order Limits, within which all works for which development consent is being sought would take place:

- **Section A** (Osbaldwick Substation): Minor works at the existing Osbaldwick Substation comprising the installation of a new circuit breaker and isolator along with associated cabling, removal and replacement of one gantry and works to one existing pylon. All substation works would be within existing operational land.
- **Section B** (Northwest of York Area): Works would comprise:
  - Reconductoring of 2.4km of the 400kV Norton to Osbaldwick (2TW/YR) overhead line and replacement of one pylon on this overhead line;
  - The new 400kV YN overhead line (2.8km), north of the proposed Overton Substation;
  - The new Shipton North and South 400kV cable sealing end compounds (CSECs) and 230m of cabling to facilitate the connection of the new YN 400kV overhead line with the existing Norton to Osbaldwick YR overhead line;
  - A new substation (Overton 400kV/275kV Substation) approximately 1km south of Shipton by Beningbrough;
  - Two new sections of 275kV overhead line which would connect into Overton Substation from the south (the 2.1km XC overhead line to the south-west and the 1.5km SP overhead line to the south-east);
  - Works to 5km of the existing XCP Poppleton to Monk Fryston overhead line between Moor Monkton in the west and Skelton in the east comprising a mixture of decommissioning, replacement and realignment. To the south and south-east of Moor Monkton the existing overhead line would be realigned up to 230m south from the current overhead line and the closest pylon to Moor Monkton (340m south-east) would be permanently removed. A 2.35km section of this existing overhead line permanently removed between the East Coast Mainline (ECML) Railway and Woodhouse Farm to the north of Overton.
- **Section C** (Moor Monkton to Tadcaster): Works proposed to the existing 275kV Poppleton to Monk Fryston (XC) overhead line north of Tadcaster (Section D) include replacing existing overhead line conductors, replacement of pylon fittings, strengthening of steelwork and works to pylon foundations.
- **Section D** (Tadcaster Area): Two new CSECs (Tadcaster East and West 275kV CSECs) would be installed approximately 3km south-west of Tadcaster and north-east of the A64/A659 junction where two existing overhead lines meet. One pylon on the existing 275kV Tadcaster Tee to Knaresborough (XD/PHG) overhead line would be replaced.

- **Section E** (Tadcaster to Monk Fryston): Works proposed to the existing 275kV Poppleton to Monk Fryston (XC) overhead line south of Tadcaster (Section D)) include replacing existing overhead line conductors, replacement of pylon fittings, strengthening of steelwork and works to pylon foundations.
- **Section F** (Monk Fryston Area): A new substation would be constructed to the east of the existing Monk Fryston Substation which is located approximately 2km south-west of the village of Monk Fryston and located off Rawfield Lane, south of the A63. A 1.45km section of the 275kV Poppleton to Monk Fryston (XC/XCP) overhead line to the west of the existing Monk Fryston Substation and south of Pollums House Farm would be realigned to connect to the proposed Monk Fryston Substation. East of the existing Monk Fryston Substation the existing 4YS 400kV Monk Fryston to Eggborough overhead line, which currently connects to the existing substation, would be reconfigured to connect to the proposed Monk Fryston Substation.

1.3.3 Figure 1 shows the locations of the substations, cable sealing ends and overhead lines involved in the project.

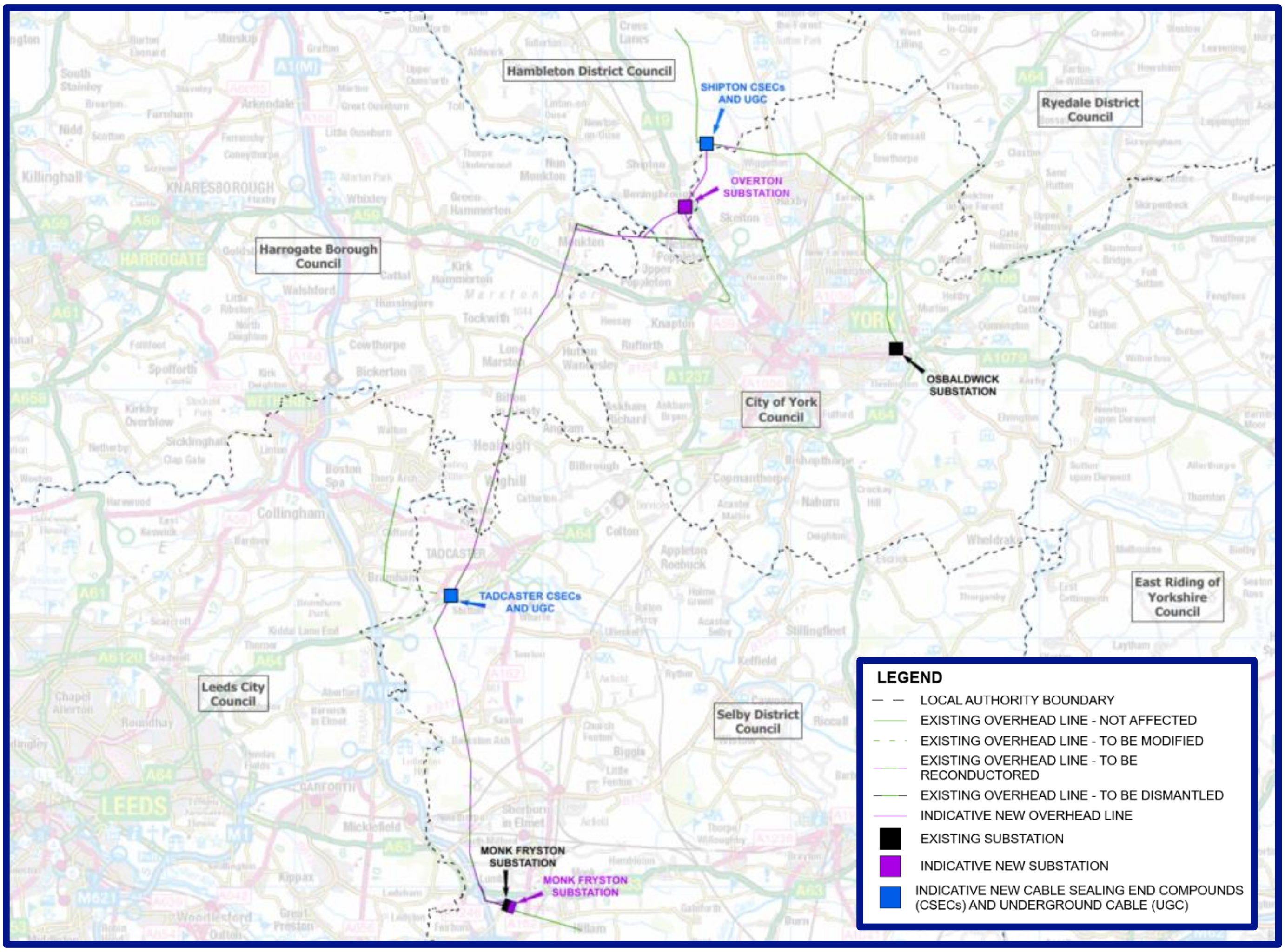

Figure 1: Project Location Plan (Source: YG-DCO-008 Volume 2, Document 2.1 Overall Location Plan [APP-015])

1.3.4 The following sections give an overview of the proposed works at each site relevant to this Design Approach to Site Specific Infrastructure document.

Overton Substation

1.3.5 As the existing 400kV Norton to Osbaldwick (2TW/YR) overhead line route to the north and the existing 275kV Poppleton to Monk Fryston (XCP) overhead line route to the south are at different voltages, a new substation (Overton 400/275kV Substation) would be needed to convert the voltage.

1.3.6 The substation would have a footprint of approximately 60,000m2 and contain four Super Grid Transformers (SGTs) which would convert the voltage levels. The SGTs would be installed within concrete bunds. The substation would also contain two full line tension, and four gantries (two per overhead line) where each overhead line connects into the substation, as well as a control building. For the purposes of the assessment, it is assumed that both the substation equipment and gantries would be up to a maximum height of 15m above the finished ground level. Underground cabling within the substation would connect one Overton - Poppleton circuit from the overhead lines into the substation. The substation would be enclosed by an electrified palisade fence in line with National Grid Electricity Transmission plc ("National Grid") standards. A small transformer compound (Northern Powergrid (North East) Plc Substation), which would be operated by Northern Power Grid, would be located outside the perimeter of the substation and connected to the substation by a short section of underground cable. A permanent access road surfaced with impermeable pavement would provide access from Overton Road. This would be designed to accommodate the Abnormal Indivisible Loads (AIL) required to install the SGTs at the substation. Drainage measures would be incorporated into the design of the substation **(Flood Risk Assessment, Appendix 5.3.9D, (Document 5.3.9D) [APP-138])** with an outfall to the Hurns Gutter. The substation would be unmanned on a permanent basis with regular maintenance visits to the Substation. Lighting at the substation would comprise security lighting on sensors. **Figure 3.2, sheet 7 and 8, Environmental Statement (ES) Chapter 3 Description of the Project Figures (Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]** shows the location of the substation.

Monk Fryston Substation

1.3.7 A new 400kV Substation would be installed adjacent to (and connecting into) the existing Monk Fryston 400/275kV Substation to enable the uprated XC overhead line to connect into the Electricity Transmission System **(see Figure 3.6, Environmental Statement (ES) Chapter 3 Description of the Project Figures (Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~])**. The new substation is required as the existing substation equipment is only rated to take a certain amount of power, and the increased rating of the XC overhead line would be above the capability of the equipment at the existing substation so cannot be used. The proposed substation would have a footprint of approximately 90,000m2 and is likely to be similar in height to the buildings and infrastructure at the existing substation (assumed for the purposes of assessment to be 15m).

1.3.8 The new substation would contain four super grid transformers (SGTs) within concrete bunds to step up the 275kV voltage of the XC overhead line to 400kV to connect into the new substation. Underground cables (approximately 600m in length) would be installed within the substation to connect one circuit of the XC overhead line to the substation. The new substation would also contain switchgear and equipment, a control building housing equipment and car parking. The substation would be enclosed by an electrified palisade fence in line with National Grid standards. A small transformer compound, which would be operated by Northern Power Grid (Northern Powergrid

(Yorkshire) Plc Substation), would be located inside the perimeter of the substation and connected to the substation by a short section of underground cable. Drainage measures will be incorporated into the design of the substation (**Appendix 5.3.9D: Flood Risk Assessment, (Document 5.3.9) [APP-138])**. At this stage of the assessment it is assumed the substation would be unmanned on a permanent basis with regular maintenance visits to the substation. Lighting at the substation would comprise security lighting on sensors.

Osbaldwick Substation

1.3.9 A new circuit breaker and isolator along with associated cabling would be installed at Osbaldwick Substation, minor works would be implemented for pylon YR001A. These would switch the arm of the pylon from which the downleads to the gantry come off and remove and dismantle an existing gantry on which one of the Norton to Osbaldwick circuits terminates to free up space for new equipment. A new gantry (up to a maximum of 15m in height) would be installed on existing operational land at the substation, and cable sealing ends would be in place, allowing a cable connection (approximately 50m) to the existing substation bay. A substation bay is a power line within an electrical substation which connects a circuit such as a feeder or a Super Grid Transformer to the substation busbar system. Each bay typically includes circuit breakers, disconnectors, earth switches, instrument transformers and surge arresters.

1.3.10 All new infrastructure as well as the requirement for any construction compounds, would be constructed within operational land at Osbaldwick Substation. Figure 3.1, **Environmental Statement (ES) Chapter 3 Description of the Project Figures (Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]** shows the Order Limits at Osbaldwick**.**

Shipton Cable Sealing End Compounds

1.3.11 A new 400kV YN overhead line would connect the existing 400kV Norton to Osbaldwick overhead line to the new 400/275kV Overton Substation. The new 400kV YN overhead line would be approximately 2.8km long and would comprise eight lattice pylons (YN001 to YN008).

1.3.12 At the northern end of the overhead line, two CSECs (Shipton North 400kV CSEC and Shipton South 400kV CSEC) would connect the new and existing overhead lines. A CSEC would be required to transition the overhead lines from overhead conductors to underground cables via overhead 'downlead' conductor connections from the adjacent terminal pylon. Approximately 230m of underground cabling would connect the two CSECs.

1.3.13 Shipton North and South CSECs would have typical footprints of 45m by 85m (3,825m2) and 40m by 45m (1,800m^2) respectively. Each CSEC would have a permanent access track with a security fence with a gate around it and be connected via a gantry (Shipton South CSEC) or an anchor block solution (Shipton North CSEC). An anchor block comprises a concrete block on the ground. The downleads from the CSEC come down off the structure and connect to this block. The blocks are smaller than gantries and can be located much closer to the pylon and are therefore used at locations, such as at Shipton North CSEC, where the space is compromised. The location of the CSECs as well as the 400kV YN overhead line is shown on Document Figure 3.2, sheets 3 to 7 of the **Environmental Statement (ES) Chapter 3 Description of the Project Figures (Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]**.

Tadcaster Cable Sealing End Compounds

1.3.14 Two new CSECs would be installed in the Tadcaster Area: Tadcaster Tee East 275kV CSEC and Tadcaster Tee West 275kV CSEC (see Figure 3.4, sheet 2, Volume 5, Document 5.4.3) with approximate footprints of 40m by 50m (2,000m2) and 31m x 37m (1,150m2) respectively. A short section (approximately 350m) of underground cable would connect to the two CSECs (see Figure 3.4, sheet 2, **Environmental Statement (ES) Chapter 3 Description of the Project Figures (Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]**. A gantry of up to 15m would be installed in Tadcaster Tee West with an anchor block solution for Tadcaster Tee East, due to the lack of space between Tadcaster Tee East and the embankment to the A64. Fencing, permanent access and permanent drainage would be installed for each CSEC.

1.3.15 Currently the existing Poppleton to Monk Fryston (XC) overhead line connects to the 275kV Knaresborough (XD/PHG) overhead line in the Tadcaster Area. There are electricity circuits between Poppleton and Knaresborough Substations, Monk Fryston and Knaresborough Substations and Monk Fryston and Poppleton Substations. The CSECs and underground cable in the Tadcaster Area are needed to create two circuits connecting Overton, Knaresborough and Monk Fryston Substations to help balance power flows on the overhead lines as a result of the increased rating requirement on the XC overhead line.

1.4 Design Context

1.4.1 As detailed in the **Design and Access Statement (DAS) (Document 7.2) [APP-203]** the development of the Project design is based on the following national policy context and National Grid's design principles which include the Holford Rules and Horlock Rules to ensure "good design" throughout the iterative design process.

National Policy Statement EN-1 – overarching national policy statement for energy (EN-1)[1]

1.4.2 Part 4.5 of EN-1 Criteria for "good design" for energy infrastructure. Paragraph 4.5.1 of EN-1 explains that whilst visual appearance is sometimes considered to be the most important factor in good design, *"high quality and inclusive design goes far beyond aesthetic considerations. The functionality of an object - be it a building or other type of infrastructure - including fitness for purpose and sustainability, is equally important. Applying "good design"* to *energy projects should produce sustainable infrastructure sensitive to place, efficient in the use of natural resources and energy used in their construction and operation, matched by an appearance that demonstrates good aesthetic as far as possible".* However, the guidance acknowledges that "*the nature of much energy infrastructure development will often limit the extent to which it can contribute to the enhancement of the quality of the area".*

1.4.3 Paragraph 4.5.3 goes on to explain that "*in light of the above, and given the importance which the Act places on good design and sustainability, the IPC (Secretary of State) needs to be satisfied that energy infrastructure developments are sustainable and, having regard to regulatory and other constraints, are as attractive, durable and adaptable (including taking account of natural hazards such as flooding) as they can be".* The Secretary of State should satisfy itself that "*the applicant has taken into account both functionality (including fitness for purpose and sustainability) and aesthetics (including its contribution to the quality of the area in which it would be located) as far as possible. Whilst the applicant may not have any or very limited choice in the physical appearance of some energy infrastructure, there may be opportunities for the applicant to demonstrate good design in terms of siting relative to existing landscape character, landform and vegetation. Furthermore, the design and sensitive use of materials in any associated development such as electricity substations will assist in ensuring that such development contributes to the quality of the area".*

1.4.4 EN-1 therefore recognises that in discussing 'good design' the concept is more than simply a consideration of visual appearance. Through the adoption of good design principles, National Grid has sought to develop its proposals in an iterative manner, considering local constraints or concerns (as set out in Chapter 4 of the DAS **(Document 7.2) [APP-203]** in terms of physical context, and Chapter 6 of the DAS **(Document 7.2) [APP-203]** in terms of feedback received), where possible, and amending the Project where feasible, taking into account alternatives, in order to avoid and minimise adverse impacts associated with the Project. The concept of good design

[1] Department of Energy and Climate Change (2011). Overarching National Policy Statement for Energy (EN-1). (online) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/fi le/47854/1938-overarching-nps-for-energy-en1.pdf (Accessed October 2022).

has therefore not only informed the selection of technologies, route of the overhead line and the location of Overton Substation, the Monk Fryston Substation, and the CSECs but also those embedded mitigation measures as set out in the Embedded Environmental Measures Schedule **(ES Appendix 3A, Document 5.3.3A(B) [REP2-018APP-094])** which will avoid, reduce or compensate for adverse effects both during the construction and operation of this Project which is of national significance.

Overarching National Policy Statement EN-5 for Electricity Networks Infrastructure (EN-5)[2]

1.4.5 Paragraphs 2.5.1 and 2.5.2 of EN-5 address the concept of good design, stating that proposals for electricity networks infrastructure should demonstrate good design in their approach to mitigating the potential adverse impacts which can be associated with overhead lines, particularly with regard to:

- biodiversity and geological conservation;
- landscape and visual;
- noise and vibration; and
- electric and magnetic fields.

1.4.6 EN-5 does not seek to direct applicants to particular sites or routes for electricity networks infrastructure (paragraph 2.2.1). It notes that the general location of electricity network projects is often determined by the location, or anticipated location, of a particular generating station in relation to the existing network. In other cases the requirement for a connection may be the result of the need for more strategic reinforcement of the network. NPS EN-5 accepts that the most direct route for a new connection may not always be the most appropriate given engineering and environmental considerations (paragraph 2.2.2).

1.4.7 Part 2 of EN-5 sets out the basis for assessing proposals. It advises for a variety of topic areas (including many of those normally covered in an Environmental Impact Assessment, and which are covered in the accompanying ES) what the applicant's own assessments should address and what principles should be adopted in decision making. It also advises on the weight to be given to certain issues and on the treatment of mitigation measures, particularly how these may be enforced through requirements or obligations.

1.4.8 Paragraph 2.8.5 of EN-5 supports the continued application of the Holford Rules, which are described below to guide the selection of routes for overhead lines. It states that the Examining Authority should expect the applicant to have followed these Rules where possible in its overhead line proposals and that the Examining Authority should take them into account in any consideration of alternatives and in considering the need for

[2] Department of Energy and Climate Change (2011). National Policy Statement for Electricity Networks Infrastructure (EN-5). (online) Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/fi le/47858/1942-national-policy-statement-electricity-networks.pdf (Accessed October 2022)

any additional mitigation measures. In addition to following the principles set out in the Holford Rules, Paragraph 2.8.10 of EN-5 explains that one of the main opportunities for mitigating potential landscape and visual impacts is the consideration of network reinforcement rather than installing an entirely new line.

The Horlock Rules

1.4.9 The Horlock Rules set out National Grid's approach to substation siting and design in the context of the company's duties under Schedule 9 of the Electricity Act[3]. The Horlock Rules were applied in determining the location of proposed site-specific infrastructure for non-linear works comprising substation and cable sealing end compounds and aim to:

- minimise environmental effects;
- seek to avoid internationally and nationally designated areas of the highest value;
- protect areas of local amenity value, important existing habitats and landscape features;
- take advantage of screening provided by landform and existing features
- utilise site layout and levels to minimise intrusion into surrounding areas;
- consider land use effects of the proposal when planning siting;
- consider options available for terminal pylons, equipment, buildings and ancillary development appropriate to individual locations, seeking to keep effects to a reasonably practical minimum;
- use space effectively to limit the development area and provide appropriate mitigation to minimise adverse effects on land use and rights of way;
- ensure the design of access road, perimeter fencing, earthworks, planting and ancillary development forms an integral part of the site layout and design to fit in with the surroundings;
- keep high voltage line entries visually separate from low voltage lines and other overhead lines to avoid a confusing appearance; and
- ensure the inter-relationship between pylons and substation structures and background and foreground features are studied to reduce the prominence of structures from main viewpoints.

The Holford Rules

1.4.10 The Holford rules refer to a set of broad principles for overhead transmission line routeing which were formulated by the late Lord Holford and published in 1959 by the Royal Society of Arts. These rules, known as the 'Holford Rules', were reviewed by National Grid in 1992 and have become accepted within the electricity transmission

[3] UK Government (1989). The Electricity Act 1989 c.29. (online) Available at: https://www.legislation.gov.uk/ukpga/1989/29/contents (Accessed October 2022).

industry as the basis for overhead transmission line routeing. The Rules remain a valuable tool for evaluating potential route options as part of the environmental assessment process. Although the Rules primarily focus on visual amenity, environmental assessment for overhead lines encompasses broader topics. The Rules are presented below.

- Rule 1: Avoid altogether, if possible, the major areas of highest amenity value, by planning the general route of the first line in the first place, even if the total mileage is somewhat increased in consequence.
- Rule 2: Avoid smaller areas of high amenity value, or scientific interests by deviation; provided that this can be done without using too many angle towers, ie the more massive structures which are used when lines change direction.
- Rule 3: Other things being equal, choose the most direct line, with no sharp changes of direction and thus with fewer angle towers.
- Rule 4: Choose tree and hill backgrounds in preference to sky backgrounds wherever possible; and when the line has to cross a ridge, secure this opaque background as long as possible and cross obliquely when a dip in the ridge provides an opportunity. Where it does not, cross directly, preferably between belts of trees.
- Rule 5: Prefer moderately open valleys with woods where the apparent height of towers will be reduced, and views of the line will be broken by trees.
- Rule 6: In country which is flat and sparsely planted, keep the high voltage lines as far as possible independent of smaller lines, converging routes, distribution poles and other masts, wires and cables, so as to avoid a concentration or ‘wirescape’.
- Rule 7: Approach urban area through industrial zones, where they exist; and when pleasant residential and recreational land intervenes between the approach line and the substation, go carefully into the comparative costs of the undergrounding, for lines other than those of the highest voltage.

1.4.11 Refer to the Design and Access Statement **(Document 7.2) [APP-203]** that presents further details on the legislative and policy context and National Grid design principles in respect of design including how it has been considered in the design evolution of the Project.

Design Parameters for Implementation

1.4.12 The Project would be constructed within the Order Limits and such Limits of Deviation (LoD), or other parameters as may be specified for the individual works.

1.4.13 As recognised in guidance provided by the Planning Inspectorate (Advice Note 9 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 a pylon to be re-sited slightly for geotechnical reasons. Therefore, to allow for this, new infrastructure would be constructed within specified Limits of Deviation (LoD) which identify a maximum distance or measurement of variation within which the works must be constructed. These comprise lateral (i.e., on the ground) and vertical limits (in relation to height).

1.4.14 The proposed LoD for the Project are shown on the **Works Plan (Document 2.6.1(B) – 2.6.6(B)) [REP1-004 – 009]** and on the parameter plans included within the **Design Drawings (Document 2.15(B))** and are required for the following non-linear works of relevance to this document:

- cable sealing end compounds (CSEC):
  - Shipton North CSEC: 10m LoD to the north, east, south and west of the CSEC;
  - Shipton South CSEC: 20m LoD to the north, east, south and west of the CSEC;
  - Tadcaster Tee-East CSEC: no LoD identified due to space constraints and use of an existing pylon;
  - Tadcaster Tee-West CSEC: 20m east and west, 25m north and south of the CSEC;
  - CSEC's would not exceed 15m in height above the finished ground level as shown on the parameter plans;
- Overton 400/275kV Substation (lateral LoD): up to 20m lateral LoD from the east, south and west of the substation boundaries and up to 10m lateral LoD from the north boundary; and
- Overton 400/275kV Substation and proposed Monk Fryston 400kV Substation (vertical LoD): both substations would not exceed 15m in height above the finished ground level as shown on the parameter plans.

Landscape Mitigation

1.4.15 The application which includes the proposed Substations at Overton and Monk Fryston and the CSECs at Tadcaster includes an Outline Landscape Mitigation Strategy at Figures 3.10 to 3.12 **(Document 5.4.3(CB)) [~~AS-017~~REP3-031].** There is flexibility for minor variations as part of the detailed design process once the engineering scheme has been fixed, provided that the design objectives of the Outline Landscape Mitigation Strategy (listed below) are still achieved. It is important that any changes to the landscape proposals still align with the local landscape character. The detailed landscape strategy that must accord with the outline landscape mitigation strategy is secured in Requirement 8(1)~~(b)~~ of the **draft DCO (Document 3.1(DB)) ~~[AS-011]~~.** The specific design objectives of the landscape mitigation for both substations and the Tadcaster CSECs is set out in Section 3.4 in the **Environmental Statement Chapter 3 Description of the Project (Document 5.2.3) [APP-075]** and are summarised as:

- retain existing trees woodland and hedgerows where possible and reinforce existing field boundary hedgerows and restore historic hedgerows where possible through additional shrub and tree planting to strengthen landscape character, maximise green infrastructure links and biodiversity and filter and screen views of new infrastructure.
- maximise the retention of best and most versatile agricultural land whilst also introducing species rich permanent grassland at the edges of fields and adjacent to hedgerows and woodland where restoration of agricultural land could be less favoured due to the shape and/or size of the land parcels following the construction of the Project and/or likely poor drainage conditions.

- new planting to reflect the overall pattern and composition of woodland blocks and belts in the vicinity of both substation sites, noting the greater quantum of existing woodland cover in the vicinity of the Monk Fryston Substation.
- adoption of permanent earth mounding generated from construction phase excavation with appropriate heights and slope profiles and woodland planting to minimise adverse landscape and visual effects and achieve a cut and fill balance of material at each substation site.

1.4.16 A range of technical constraints to the design of landscape mitigation apply including the need to ensure that tree planting is located outside the easements of underground services (most notably associated with the Tadcaster CSECs) and overhead lines and downleads in the vicinity of the substations. There is a requirement for an offset both sides of the outer cable channel to avoid impact on the cable, with the offset to be determined at detailed design stage. Clearances are also required beneath the downleads from the overhead line to maintain safety clearances, which restricts both tree planting and earth mounding.

2. Site Location and Context

2.1 Baseline Landscape Context

2.1.1 The landscape context of the proposed CSEC's, Overton Substation and Monk Fryston Substation, where there is the greatest opportunity for landscape mitigation using earth mounding and new planting, is set out below with reference to **Section 6.5 of ES Chapter 6 Landscape and Visual (Document 5.2.6) [APP-078], Appendix 6D Landscape Character Baseline (Document 5.3.6E) [APP-112]** and Figures 6.11, 6.15, 6.16 and 6.17 of **ES Chapter 6 Landscape and Visual Figures (Document 5.4.6) [APP-167].**

Shipton CSECs and Overton Substation

2.1.2 At a national level the proposed infrastructure is located in National Character Area 28: Vale of York. The Statements of Environment Opportunity most relevant to the Project, identify opportunities within the existing agricultural systems to enhance landscape character that is stated to include the management, restoration and thickening of existing hedgerows and the planting of new hedgerow trees. Other opportunities are stated to include the restoration and management of field ponds and increasing the network of species rich meadows.

2.1.3 At a local level the proposed infrastructure is located in the Huby and Shipton Vale Farmland Landscape Character Area. The most relevant key characteristics when considering landscape mitigation are summarised as:

- A simple, open landscape of flat floodplain with only occasional undulations and localised higher ground.
- Very large arable fields, though linear field patterns remain intact in places.
- Woodland includes conifer plantations and native woodland along watercourses.
- An open landscape, though views are filtered by multiple layers of trees.
- A busy landscape of roads, railway and other infrastructure.
- Areas prone to flooding.

2.1.4 The Siting areas for the Shipton CSEC and Overton Substation are dominated by medium to large scale arable fields on low lying land, with ground levels typically varying between 12m and 15m Above Ordnance Datum (AOD). Field boundaries are typically managed hedgerows with trees and at Overton there are isolated remnant hedgerows and hedgerow trees where the original field boundaries have been lost through field amalgamation. Woodland is infrequent, being typically small-scale blocks at the corner of fields including most notably north of Shipton CSEC. There are occasional narrow and intermittent belts including planting along the East Coast Mainline Railway (ECMLR). Overton Road crosses the ECMLR west of the Overton Substation Siting Area with embankment north and south of the railway, with the bridge approximately 4m above the railway.

Tadcaster CSECs

2.1.5 At a national level the proposed infrastructure is located in National Character Area 30: Southern Magnesian Limestone. The most relevant Statements of Environment Opportunity identify opportunities to minimise visual impact and incorporate green infrastructure, and whilst this is related to 'major landuse change' it is still of some relevance to the smaller scale land-use changes associated with the Tadcaster CSECs. Other measures include the introduction of permanent unimproved limestone and neutral grassland margins to arable field edges.

2.1.6 At a local level the proposed infrastructure is located in the West Selby Limestone Ridge Landscape Character Area and Locally Important Landscape Area (a non-statutory designation). The most relevant key characteristics when considering landscape mitigation are summarised as:

- Large scale rolling arable farmland.
- Irregularly shaped, large scale arable fields, defined by hedgerows and field margin buffers with intermittent hedgerow trees.
- Major transport links dissect this landscape, including the main trunk roads A1, A63, and A64.

2.1.7 The Siting areas for the Tadcaster CSECs are located on gently undulating arable farmland at around 50m AOD. The highway embankment of the A64 dual carriageway lies close to the proposed eastern CSEC. The A659 is located to the west of the Project and is defined by a low clipped intermittent hedgerow and occasional trees. The northern and southern boundaries of the Order Limits, including the temporary construction compounds, cross open arable farmland. Blocks of plantation woodland lie between the Project and the dwellings of Red Brick Farm and Brick House Farm on Garnet Lane, and this planting provides a buffer between the dwellings and the existing infrastructure associated with the existing 275kV XD Tadcaster Tee to Knaresborough overhead line and existing 275kV XC Poppleton to Monk Fryston overhead line.

Monk Fryston Substation

2.1.8 At a national level the proposed infrastructure is located in National Character Area 30: Southern Magnesian Limestone. The most relevant Statements of Environment Opportunity identify opportunities to minimise visual impact and incorporate green infrastructure, and whilst this is related to 'major landuse change' it is still of some relevance to the land-use changes associated with the Monk Fryston Substation. Other measures include the introduction of permanent unimproved limestone and neutral grassland margins to arable field edges.

2.1.9 At a local level the proposed infrastructure is located in the West Selby Limestone Ridge Landscape Character Area. The most relevant key characteristics when considering landscape mitigation are summarised as:

- Large scale rolling arable farmland.
- Irregularly shaped, large scale arable fields, defined by hedgerows and field margin buffers with intermittent hedgerow trees.
- Major transport links dissect this landscape, including the main trunk roads A1, A63, and A64.

2.1.10 The Siting area for the Monk Fryston Substation lies adjacent to the eastern and north-eastern edge of the existing substation on relatively flat arable farmland at between approximately 34m and 39m AOD. Mature woodland belts are located to the south and east, set within a wider undulating arable landscape. Field boundaries close to the Siting Area are typically defined by low clipped hedgerows, intermittent with frequent gaps and include two sections of hedgerow that cross the site of the proposed substation. Multiple high voltage overhead lines connect to the substation from the south and west and the existing 400kV 4YS overhead line crosses the landscape to the east of the substation. A grassed earth bund approximately 4m high with 1 in 3 slopes is located along the northern edge of the existing substation site. There are some remnant Hawthorn bushes on the bund.

Examples of Existing Infrastructure

2.2 Existing Substations

The following images show the existing Monk Fryston Substation.

Figure 2: Existing Substation - Monk Fryston (Source: MM Site Visit)

Figure 3: Existing Substation - Monk Fryston (Source: MM Site Visit)

2.3 Existing Cable Sealing Ends (CSE)

CSE with Gantries

The image below shows a cable sealing end with gantries at Monk Fryston 400kV Substation.

Figure 4: Existing CSE with gantries (Source: MM Site Visit)

CSE with Anchor Blocks

The image below shows Kingswell anchor block solution cable sealing compound in Aberdeen.

Figure 5: Existing CSE with Anchor Blocks (Source: Corrie Construction)

3. DCO Design and Operational Function

3.1.1 This section of the document outlines the electrical equipment present at each substation and its operational function. The figures below show 3D images of equipment included in the application document - Construction Plans **(Document 2.16) [APP-065].**

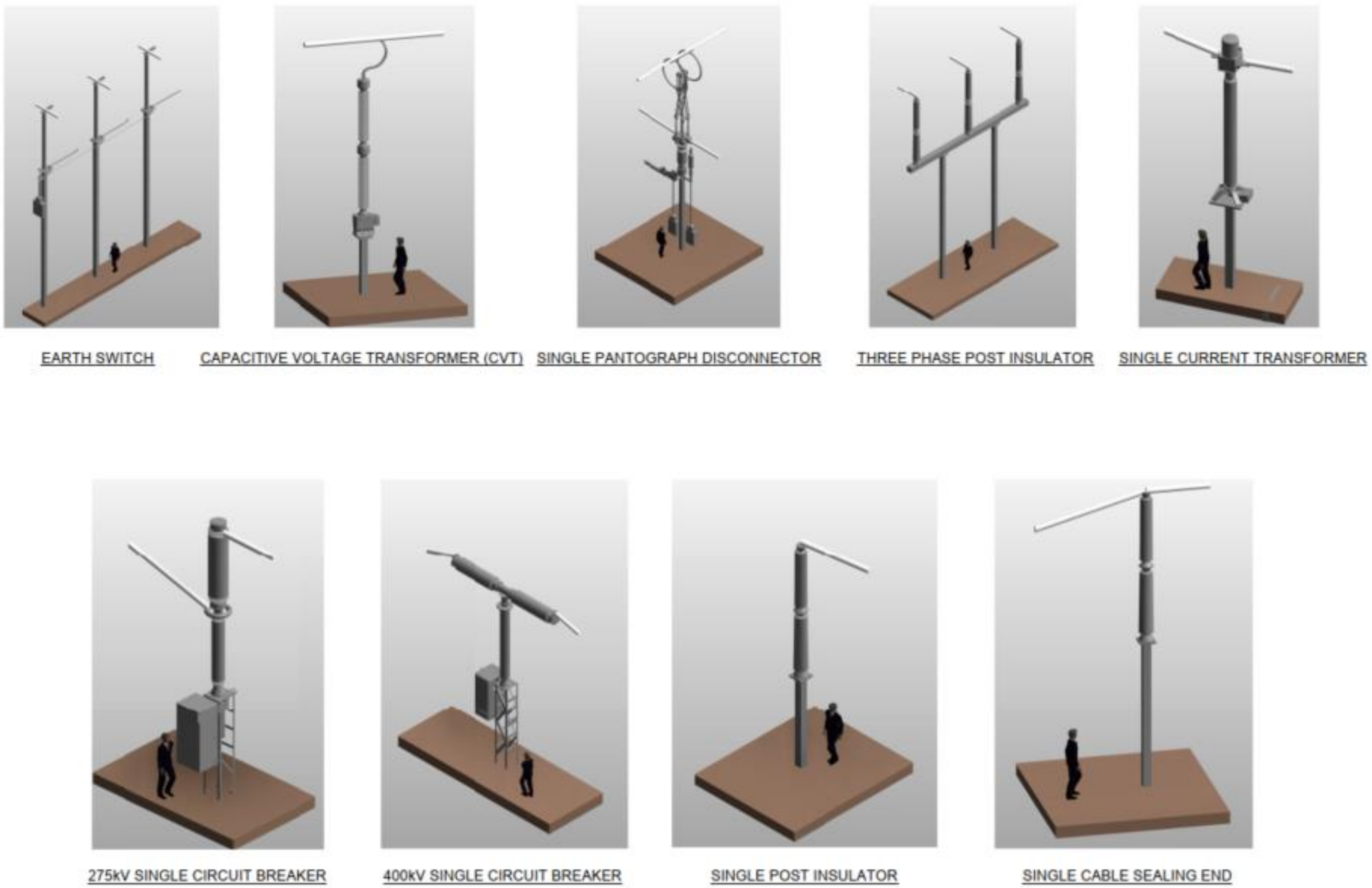

Figure 6: Substation Electrical Equipment (Source – (Construction Plans Document 2.16 DCO_CO/PS/6_01) [APP-065]

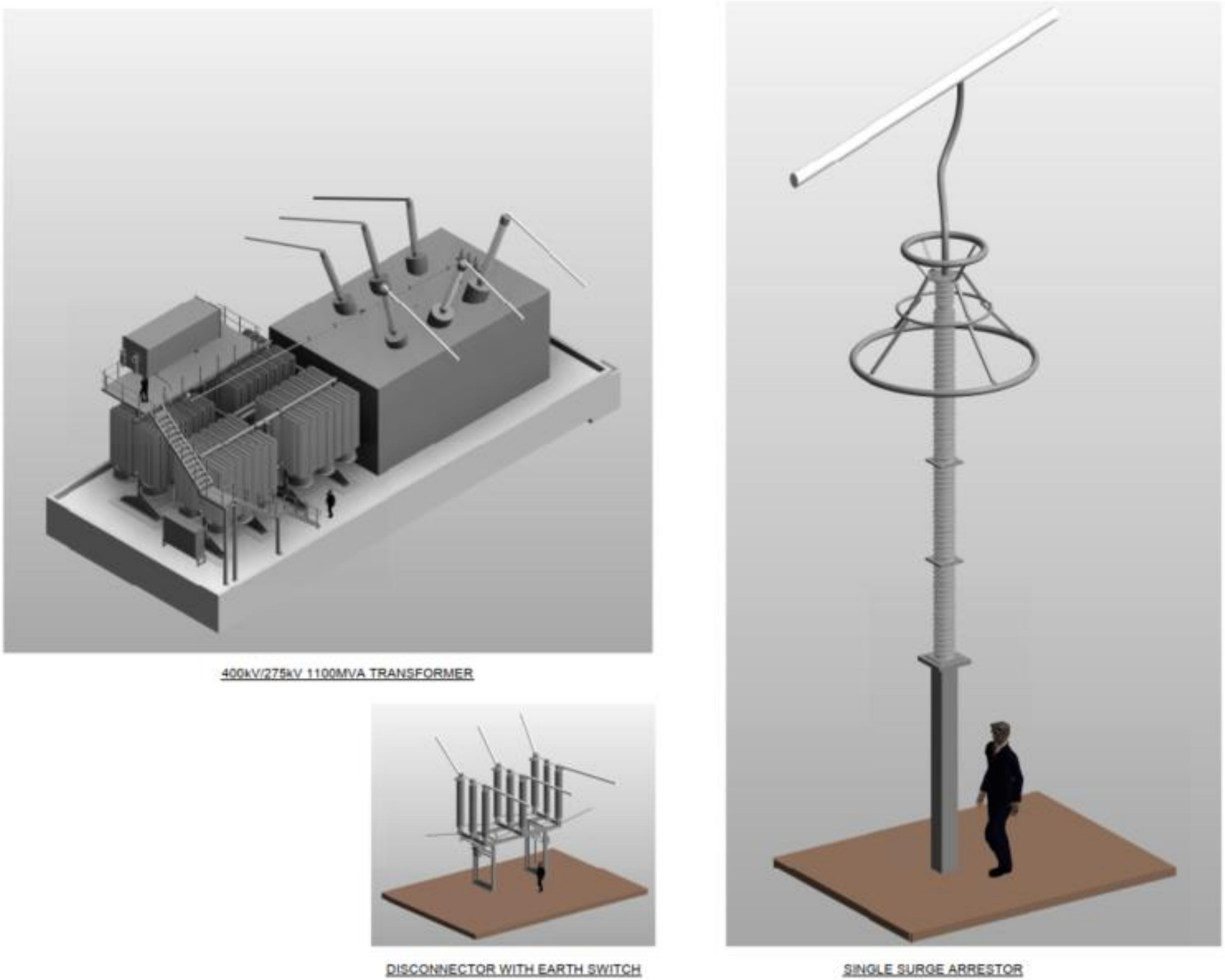

Figure 7: Substation Electrical Equipment (Source Document 2.16 [APP-065] DCO_CO/PS/6_02)

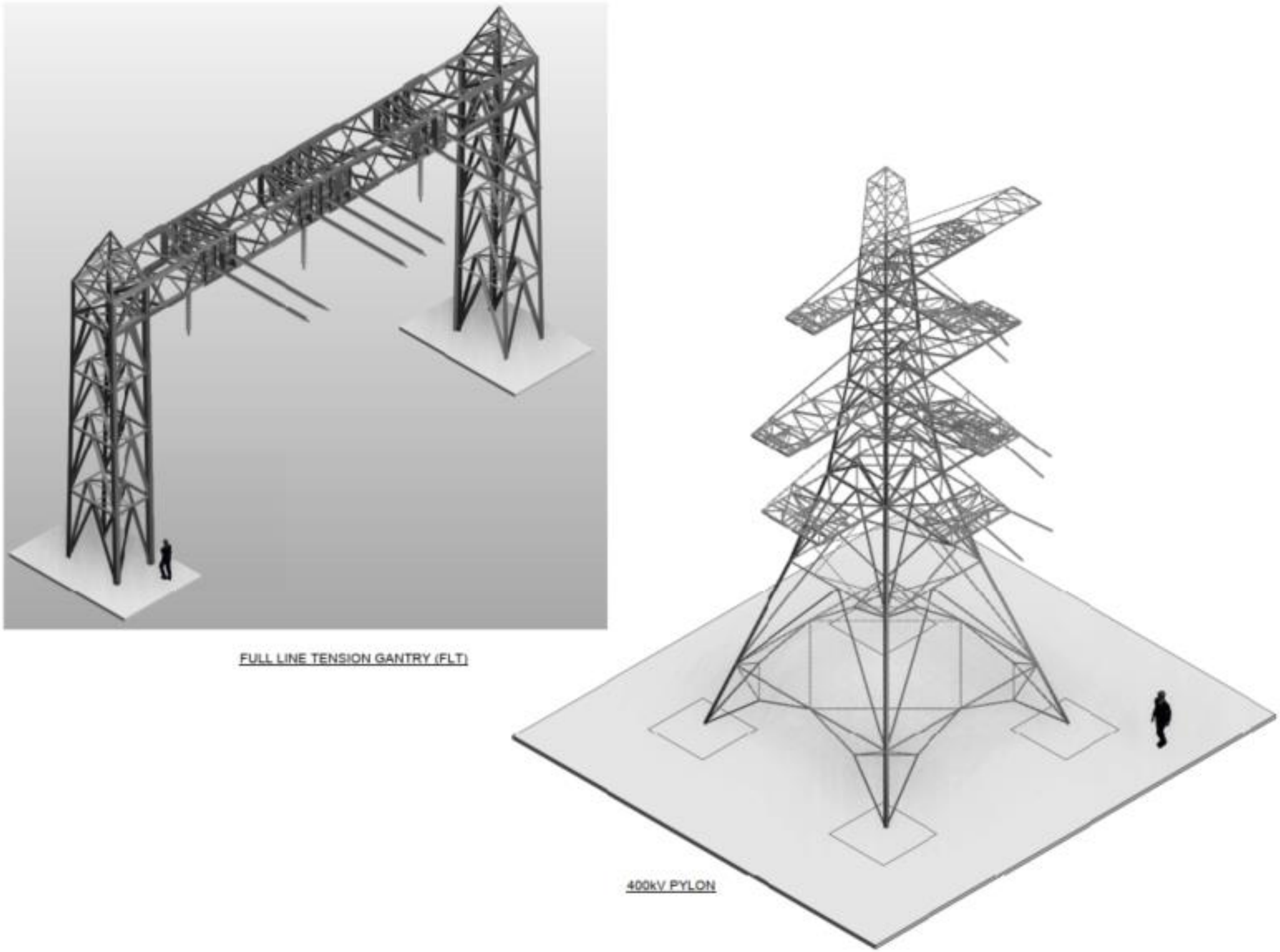

Figure 8: Substation Structures (Source Document 2.16 [APP-065] DCO_CO/PS/6_03)

3.2 Substations

Overton 275kV/400kV

3.2.1 Substations are a method of controlling power flows and voltages between the transmission system and distribution system. The typical designs for the proposed new Overton Substation are shown in **Design Drawings (Document 2.15(B))** Refer to the following drawings: Substation Parameter Plan - Overton DCO_DE/PS/14_01, Indicative Substation Layout - Overton DCO_DE/PS/14_02 and Indicative Substation Elevation - Overton DCO_DE/PS/14_03.

3.2.2 The typical design is presented in the diagrammatic illustration below. This illustration explains the function of the various elements required.

Key:

A. Diesel Generator: provides backup power, approximate dimensions: 9x4x2m (LxWxH).

B. National Grid Control & Amenity Building: Houses 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: 53.9x14.3x7.3m (LxWxH).

C. Circuit Breaker (400kV): interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5m x 1m x7.4m (LxWxH).

D. DNO Building: houses the 11kV/415V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 4x4x5m (LxWxH).

E. Cable Sealing End (275kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1x1.5x6.8m (LxWxH) per individual unit.

F. Overhead Line Gantry (400kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 25x2.5x15m (LxWxH).

G. Overhead Line Gantry (275kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 15x1x12m (LxWxH).

H. Post Insulators: Support HV conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8.5m (400kV).

I. Cable Sealing Ends (400kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5x1.5x8.6m (LxWxH) per individual unit.

J. Full Line Tension Gantry (400kV): The overhead line conductors terminate on this structure. Construction from tubular steel. Approximate dimensions: 25x2x15m (LxWxH).

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

L. Super Grid Transformers (SGTs): step down the voltage and regulate power flow with a cooler bank attached to each side. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 15x25x11m (LxWxH).

M. Earth Switch/Post Insulator (400kV): to apply safety precautions for work on this equipment and supports HV conductor to keep it away from earth. Typically, porcelain insulator above a steel structure. Approximate dimensions: 15x1x12m (LxWxH) per individual unit.

Illustrated with planting at full maturity

Figure 9: Overton Substation Illustration

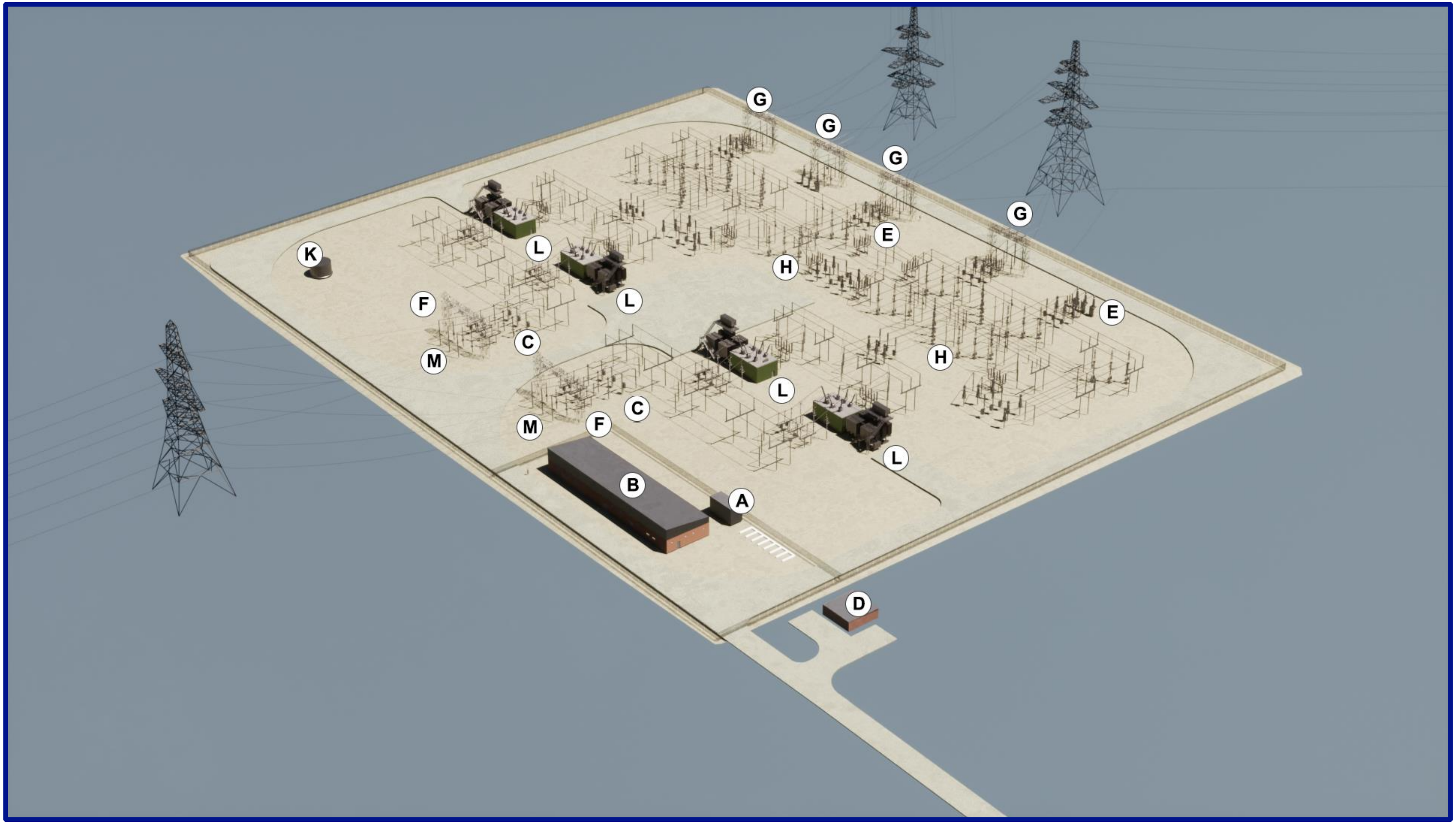

Figure 10: Overton Substation Illustration Labelled (as detailed in Key at 3.2.2 above)

Monk Fryston 275kV/400kV

3.2.3 The typical designs for the proposed new Monk Fryston Substation are shown in **Design Drawings (Document 2.15(B)).** Refer to the following drawings: Substation Parameter Plan – Monk Fryston DCO_DE/PS/15_01, Indicative Substation Layout – Monk Fryston DCO_DE/PS/15_02 and Indicative Substation Elevation – Monk Fryston DCO_DE/PS/15_03.

3.2.4 The typical design is presented in the diagrammatic illustration below. This illustration explains the function of the various elements required. Note the existing Monk Fryston Substation is also shown in the illustration.

Key:

A. Diesel Generator: provides backup power, approximate dimensions: 9x4x2m (LxWxH).

B. National Grid Control & Amenity Building: Houses 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: 32x26x8m (LxWxH).

C. Circuit Breaker (400kV): interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5mx1mx7.4m (LxWxH).

D. DNO Building: houses the 11kV/415V transformer for site supplies. Modular steel prefabricated building. Approximate dimensions: 4x4x5m (LxWxH).

E. Cable Sealing End (275kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1x1.5x6.8m (LxWxH) per individual unit.

F. Overhead Line Gantry (400kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 25x2.5x15m (LxWxH).

G. Overhead Line Gantry (275kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 15x1x12m (LxWxH).

H. Post Insulators: Support HV conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8.5m (400kV).

I. Full Line Tension Gantry (400kV): The overhead line conductors terminate on this structure. Construction from tubular steel. Approximate dimensions: 25x2x15m (LxWxH).

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

K. Super Grid Transformers (SGTs): step down the voltage and regulate power flow with a cooler bank attached to each side. Acoustic enclosures attenuate noise and are constructed from modular steel frames. Approximate dimensions: 15x25x11m (LxWxH).

L. Earth Store and Workshop: Storage of safety equipment and tools. Steel shipping containers. Approximate dimensions: 10x3x3m (LxWxH).

M. Earth Switch/Post Insulator (400kV): to apply safety precautions for work on this equipment and supports HV conductor to keep it away from earth. Typically, porcelain insulator above a steel structure. Approximate dimensions: 15x1x12m (LxWxH) per individual unit.

Figure 11: Monk Fryston Substation Illustration

Illustrated with planting at full maturity

Figure 12: Monk Fryston Substation Extension Illustration Labelled (as detailed in Key at 3.2.4 above)

Osbaldwick 400kV

3.2.5 The typical designs for the proposed Osbaldwick Substation are shown in **Design Drawings (Document 2.15(B)).** Refer to the following drawings: Substation Parameter Plan - Osbaldwick DCO_DE/PS/16_01, Indicative Substation Layout – Osbaldwick DCO_DE/PS/16_02 and Indicative Substation Elevation - Osbaldwick DCO_DE/PS/16_03.

3.2.6 The typical design is presented in the diagrammatic illustration below. This illustration explains the function of the various elements required.

Key:

A. Circuit Breaker (400kV): interrupts power flow. Materials: mixture of metal body and silicone/porcelain insulators. Approximate dimensions: 5m x 1m x7.4m (LxWxH).

B. Overhead Line Gantry (400kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 25x2.5x15m (LxWxH).

C. Post Insulators: Support HV conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8.5m (400kV).

D. Cable Sealing Ends (400kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5x1.5x8.6m (LxWxH) per individual unit.

E. Earth Switch/Post Insulator (400kV): to apply safety precautions for work on this equipment and supports HV conductor to keep it away from earth. Typically, porcelain insulator above a steel structure. Approximate dimensions: 15x1x12m (LxWxH) per individual unit

Figure 13: Osbaldwick Substation Illustration

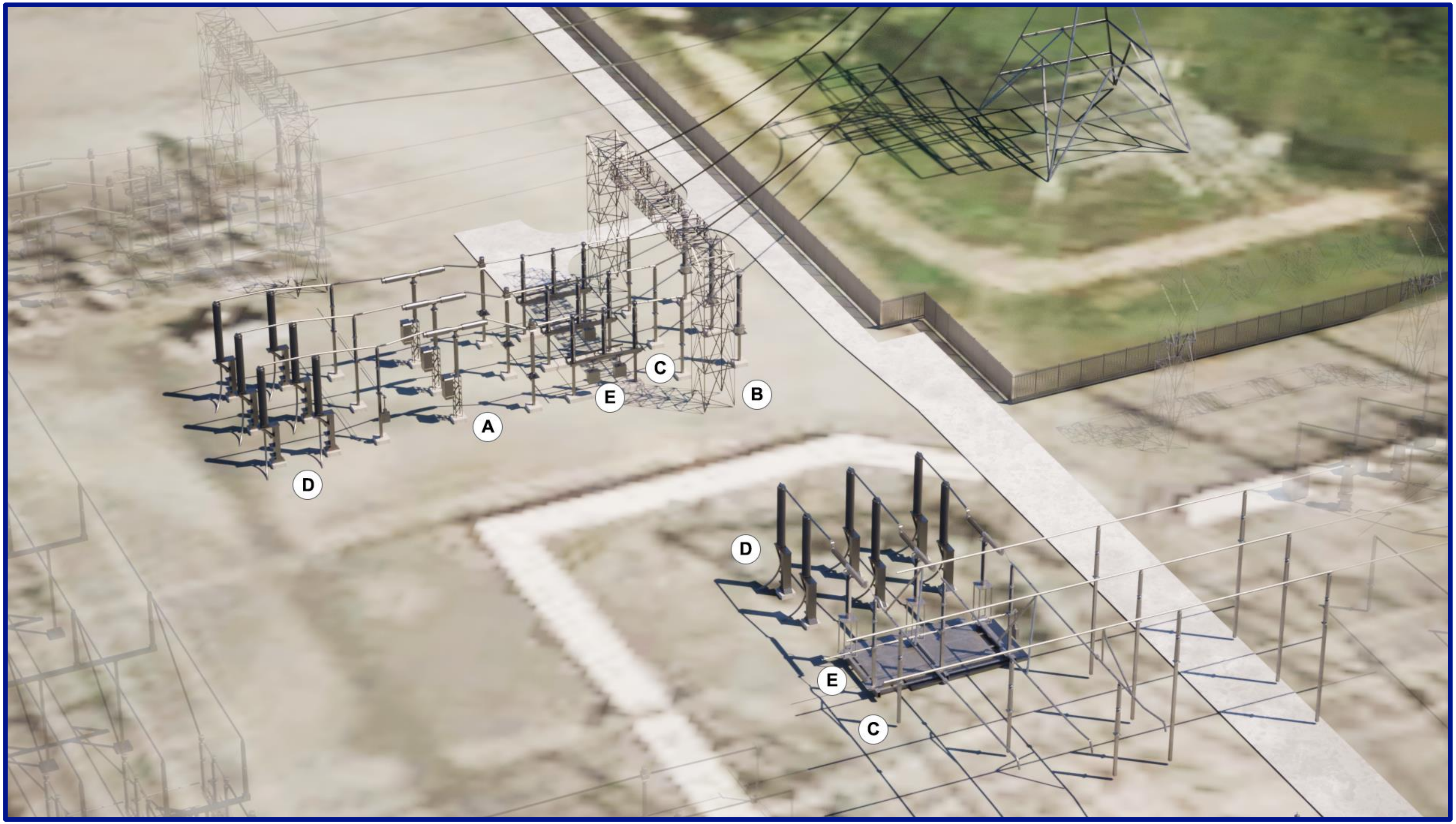

Figure 14: Osbaldwick Substation Illustration Labelled (as detailed in Key at 3.2.6 above)

3.3 CSE Compounds

Shipton

3.3.1 The typical designs for the proposed Shipton cable sealing end compounds are shown in **Design Drawings (Document 2.15) [APP-064].** Refer to the following drawings: Parameter Plan for Shipton North 400kV Cable Sealing End Compound DCO_DE/PS/17_01, Indicative Cable Sealing End Compound Layout – Shipton North 400kV Cable Sealing End Compound DCO_DE/PS/17_02, Indicative Cable Sealing End Compound Elevation – Shipton North 400kV Cable Sealing End Compound DCO_DE/PS/17_03, Parameter Plan for Shipton South 400kV Cable Sealing End Compound DCO_DE/PS/18_01, Indicative Cable Sealing End Compound Layout – Shipton South 400kV Cable Sealing End Compound DCO_DE/PS/18_02 and Indicative Cable Sealing End Compound Elevation – Shipton South 400kV Cable Sealing End Compound DCO_DE/PS/18_03.

3.3.2 The typical design is presented in the diagrammatic illustration below. This illustration explains the function of the various elements required.

Key:

A. Overhead Line Gantry (400kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 25x2.5x15m (LxWxH).

B. Post Insulators: Support HV conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8.5m (400kV).

C. Cable Sealing Ends (400kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1.5x1.5x8.6m (LxWxH) per individual unit.

D. Earth Switch/Post Insulator (400kV): to apply safety precautions for work on this equipment and supports HV conductor to keep it away from earth. Typically, porcelain insulator above a steel structure. Approximate dimensions: 15x1x12m (LxWxH) per individual unit.

Figure 15: Shipton Cable Sealing End Compounds Illustration

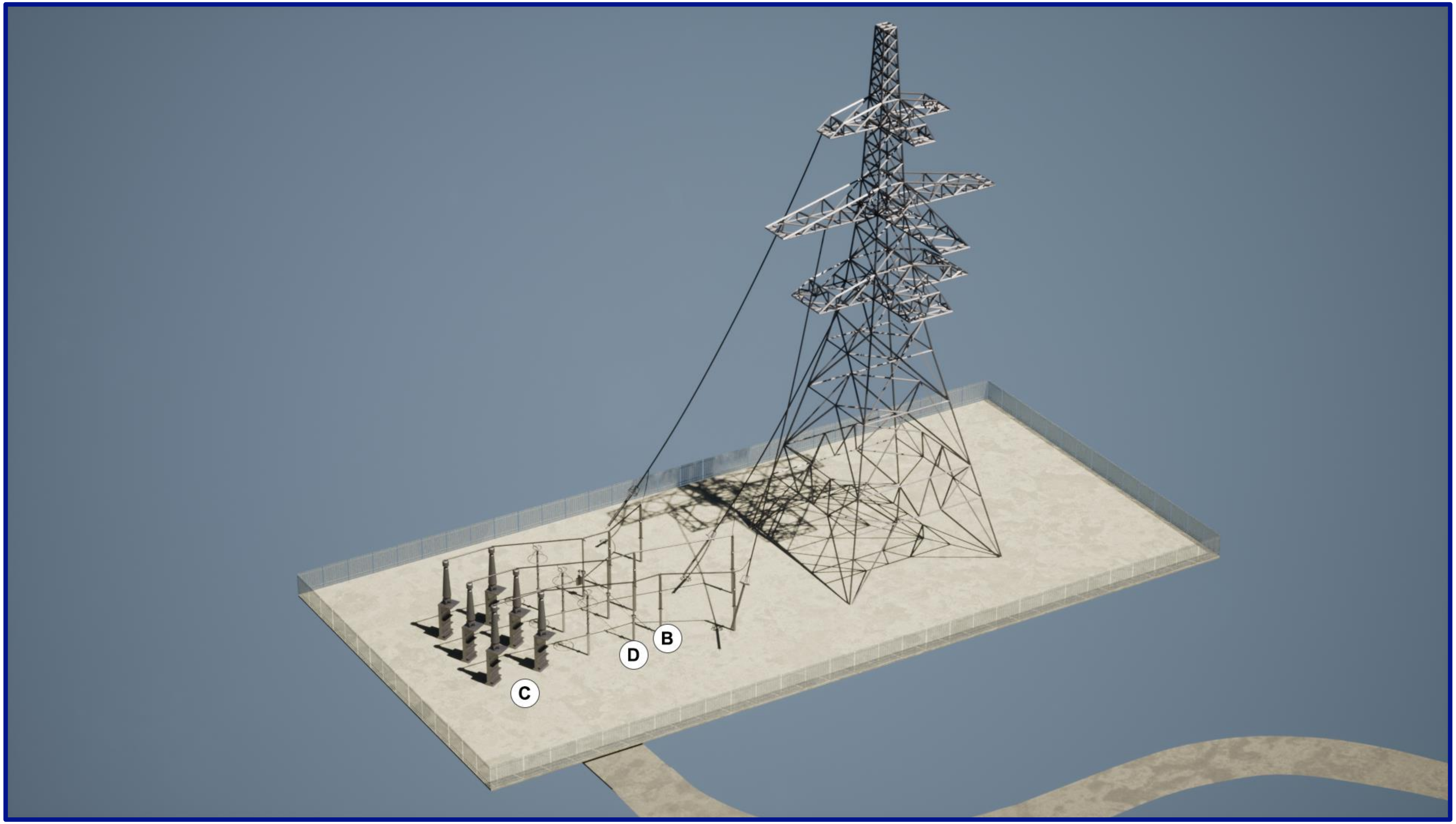

Figure 16: Shipton North Cable Sealing End Compound Illustration (as detailed in Key at 3.3.2 above)

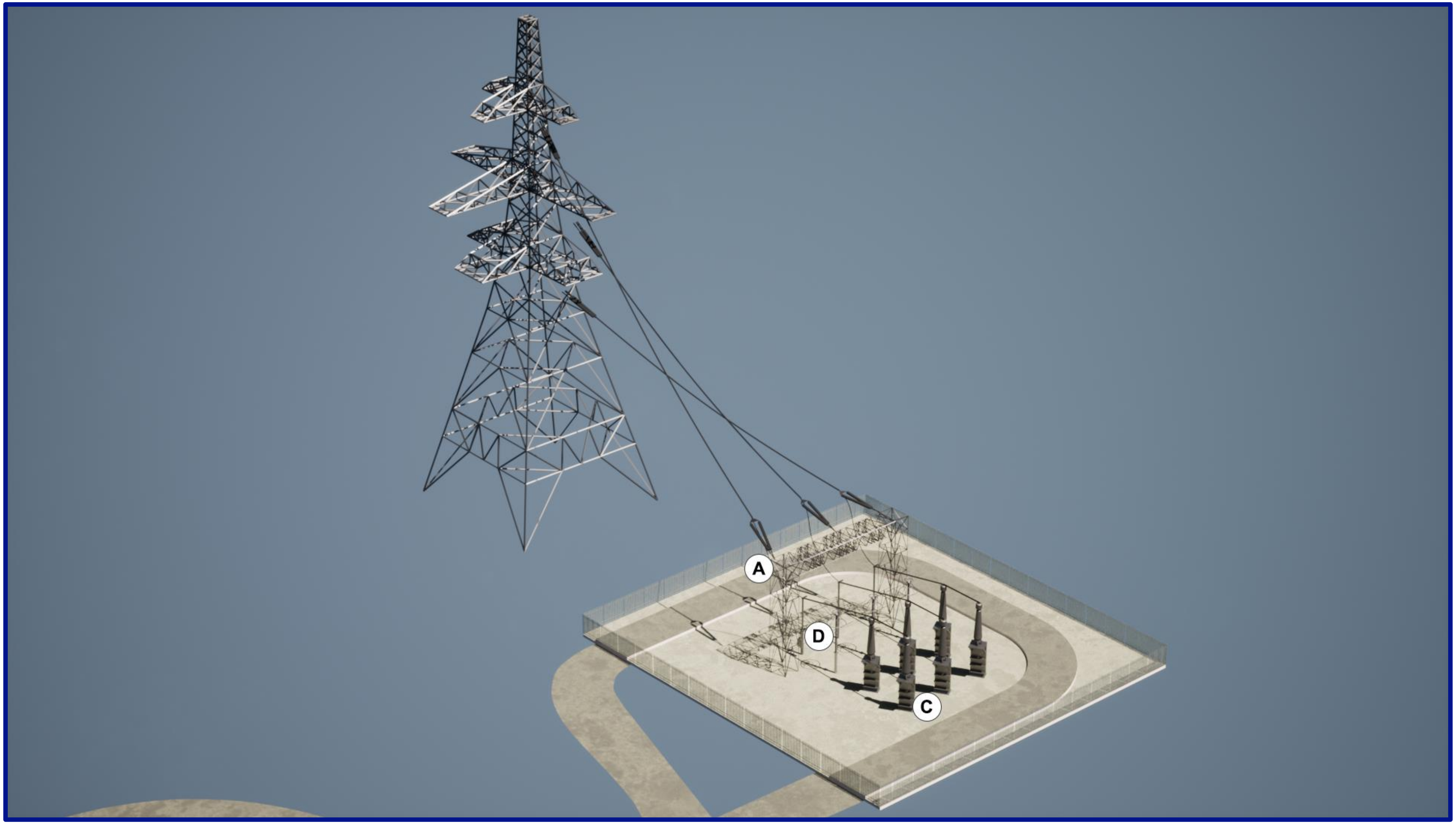

Figure 17: Shipton South Cable Sealing End Compound Illustration (as detailed in Key at 3.3.2 above)

Tadcaster

3.3.3 The typical designs for the proposed Shipton cable sealing ends are shown in **Design Drawings (Document 2.15) [APP-064].** Refer to the following drawings: Parameter Plan for Tadcaster West 275kV Cable Sealing End Compound DCO_DE/PS/19_01, Indicative Cable Sealing End Compound Layout – Tadcaster West 275kV Cable Sealing End Compound DCO_DE/PS/19_02, Indicative Cable Sealing End Compound Elevation – Tadcaster West 275kV Cable Sealing End Compound DCO_DE/PS/19_03, Parameter Plan for Tadcaster East 275kV Cable Sealing End Compound DCO_DE/PS/20_01, Indicative Cable Sealing End Compound Layout – Tadcaster East 275kV Cable Sealing DCO_DE/PS/20_02 and Indicative Cable Sealing End Compound Elevation – Tadcaster East 275kV Cable Sealing End Compound DCO_DE/PS/20_03.

3.3.4 The typical design is presented in the diagrammatic illustration below. This illustration explains the function of the various elements required.

Key:

A. Cable Sealing End (275kV): interface between air insulated conductor (busbar) and underground cables, one required per cable. Typically, a silicone insulator above a steel structure. Approximate dimensions: 1x1.5x6.8m (LxWxH) per individual unit.

B. Overhead Line Gantry (275kV): transfers high voltage conductors from an overhead line under tension to substation equipment. Approximate dimensions: 15x1x12m (LxWxH).

C. Post Insulators: Support HV conductors to keep them away from earth. Typically, porcelain insulators above a steel structure. The height of this equipment would be approximately 8.5m (275kV).

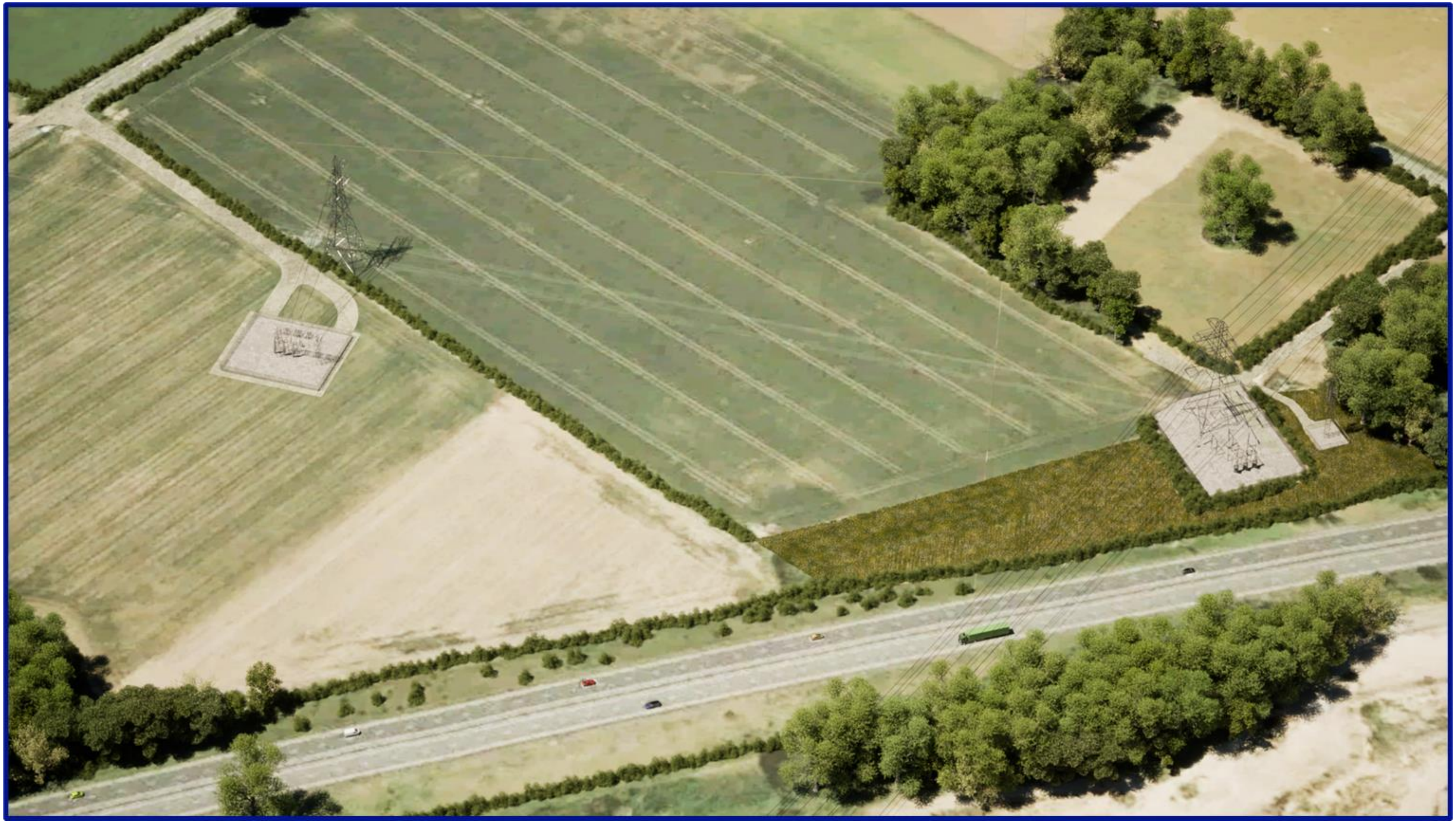

Figure 18: Tadcaster Cable Sealing End Compounds Illustration

Illustrated with planting at full maturity

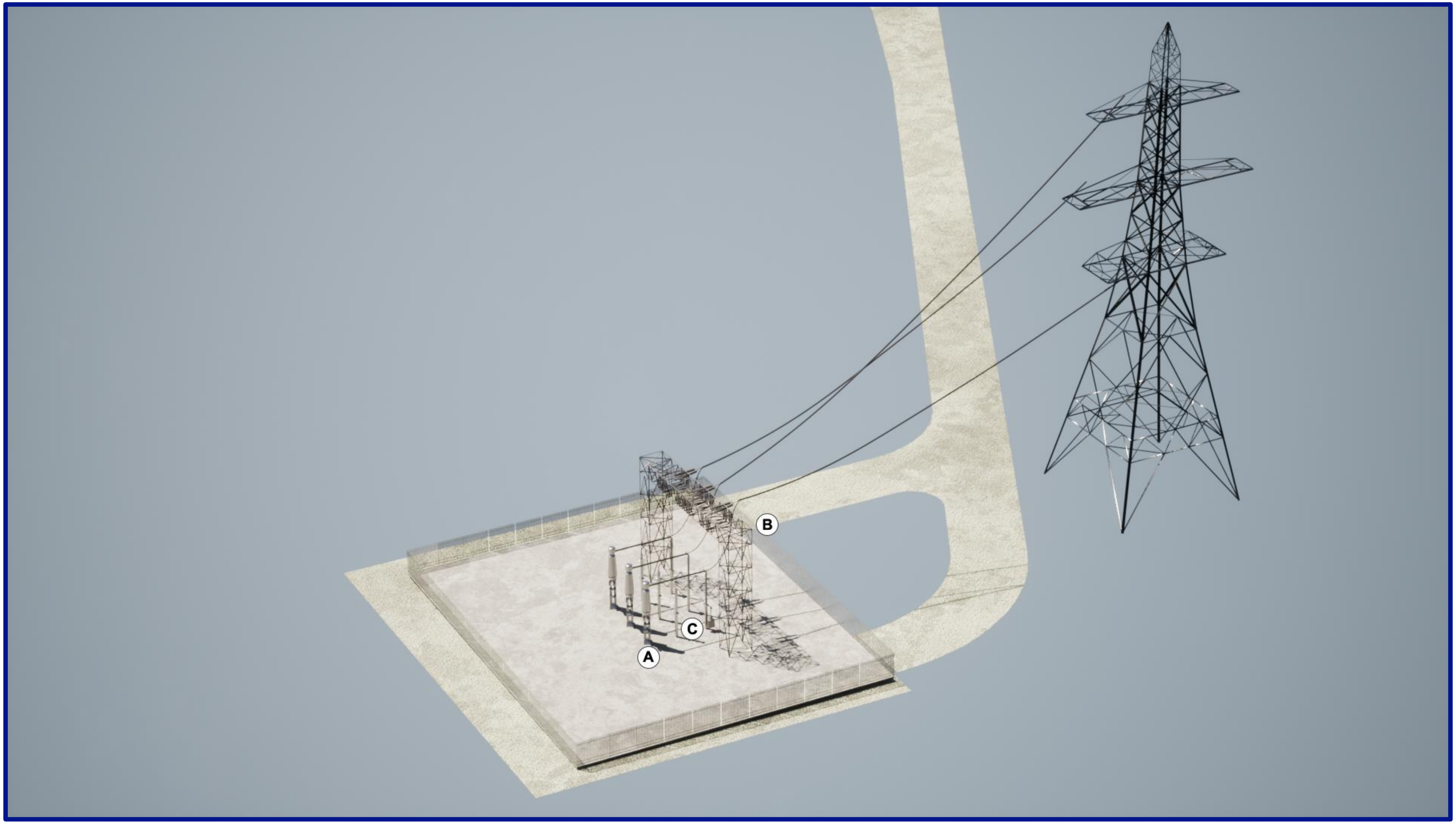

Figure 19: Tadcaster West Cable Sealing End Compound Illustration (as detailed in Key at 3.3.4 above)

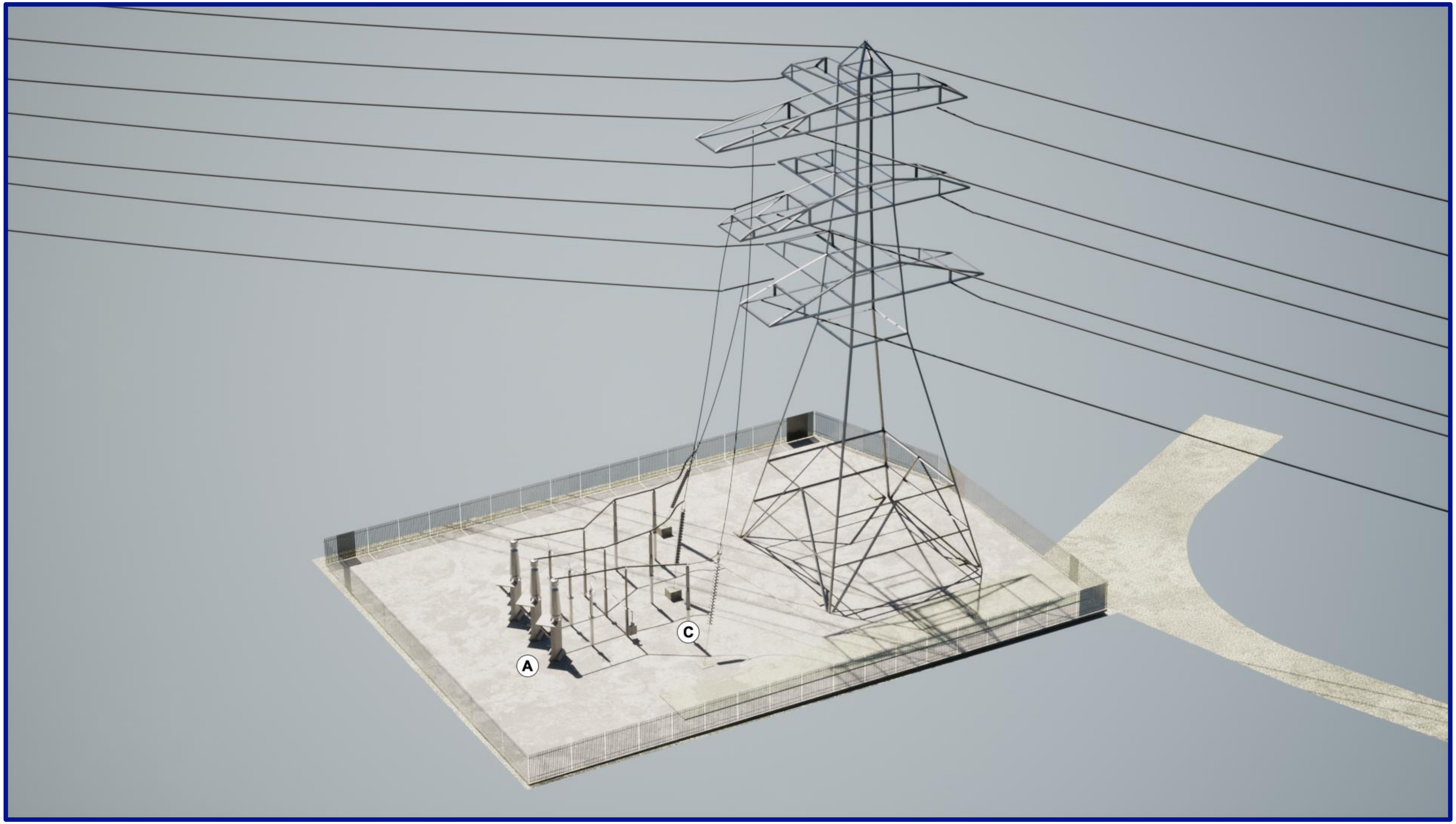

Figure 20: Tadcaster East Cable Sealing End Compound Illustration (as detailed in Key at 3.3.4 above)

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

4.1 Substations

General Maintenance requirements

4.1.1 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 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 should be carefully evaluated with this factor in mind.

Overton 275kV/400kV

4.1.2 This section sets out the design principles that led to the development of the substation layout, and explains where there is scope for variation within the detailed design. In summary the areas where there is scope for variation are:

- location based on the limits of deviation;
- the external finish of substation buildings and acoustic enclosures;
- the boundary treatments and surfacing; and
- the landscape mitigation proposals.

Substation limits of deviation (LoD) and Parameters

4.1.3 Overton substation is subject to the limits of deviation as described in Article 5 of the **draft DCO (Document 3.1(DB)) [AS-011]** and as shown on Section B of the **Work Plan (Document 2.6.2(B) [REP1-005]**). The substation can be moved in accordance with the LoD should the need arise in detailed design due to any unforeseen conditions.

4.1.4 Overton Substation is also subject to parameters set out in the Design Drawings **(Document 2.15(B))** which specifies where within the substation footprint, certain equipment can be located, and specifies the maximum height of the equipment.

Design Principles

Size and layout of substation compound

4.1.5 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 in it, protect the equipment in the substation and allow safe access to install, maintain, remove all or part of the substation. These design requirements and the dimensions of the electrical equipment determine the overall size of the substation. Refer to the Parameter Plan DCO_DE/PS/14_01 within **Design Drawings (Document 2.15(B))**.

Separation between electrical equipment

4.1.6 The requirements National Grid adheres to set out the basic dimensions 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".

4.1.7 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 design their systems so that no more than one part of the system needs to be switched off for any work to be done on it.

4.1.8 Generally, the distance required between equipment, and between 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.

4.1.9 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.

Arrangement of the substation

4.1.10 As shown in the illustration in Section 3.0, Overton Substation consists of a single electrical compound containing the 400kV and 275kV parts. Within the overall compound, a control building is separately fenced off to prevent unauthorised access to the main electrical HV 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.

4.1.11 At Overton Substation, the proposed 400kV overhead line approaches from the north and has dictated the position of the 400kV part of the substation, which is to the north of the 275kV part of the substation. Similarly, the 275kV overhead lines exit the substation at the south and have dictated the positioning of the 275kV part. The substation has also been located to avoid a number of constraints in the area, such as the East Coast Main Line, a large existing water pipeline, and to avoid flood zones.

4.1.12 In general, the buildings are positioned where there is space and so as not to increase the overall footprint of the substation.

Electrical equipment

4.1.13 The electrical equipment required to operate the substation is governed by standards and type tests which confirm a product meets strength and capability requirements.

4.1.14 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

Scope for Variation

4.1.15 The following sections set out where there is and isn't scope for variation of the design and how elements for the substation will look. The areas where there is no scope for variation are due to equipment required to meet technical and safety standards. Where there is scope for variation in the design, this document sets out what the scope for variation is.

Finished Site Level

4.1.16 The proposed substation has been located out of all flood zones (located in the southeast of the field, beside Hurns gutter) and therefore does not pose a flood risk as per national planning requirements. However, for National Grid policy, a 1:1000 year + CC flood resilience level is required. For this reason, the site has been proposed to be raised on average 600mm across its area. Material will likely be imported unbound, free drainage engineered fill.

4.1.17 The site finish level is shown as 13.71mAOD on the Substation Elevation drawing DCO_DE/PS/14_03 within the **Design Drawings (Document 2.15(B))** updated as submitted at Deadline 2. The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the substation must be built within a maximum of 15m above the finished site level.

4.1.18 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.

Substation buildings

4.1.19 For the control buildings, there is some scope for variation in the external finishes. The buildings could be clad, red brick, or a combination of the two.

4.1.20 For the Northern PowerGrid (Northwest) Plc Substation building, prefabricated buildings are generally preferred. This gives programme and safety benefits. For example, the finishes can be applied in a controlled environment and the construction time on a substation can be reduced.

4.1.21 The smaller buildings will typically be prefabricated, fibreglass or steel containers. The preferred colour is RAL 6003 Olive Green, although RAL 7037 Grey may be considered.

The following figures show the acceptable building finishes.

Figure 21: Red Brick (Source: Ammaari Stones)

Figure 22: Grey Roof Cladding (Source: Cladco)

Figure 23: Green Cladding (Source: Winery Design)

Figure 24: Grey Cladding (Source: Cladding Coatings

The following figures show the Overton control building with the range of acceptable finishes.

Figure 25: Overton Control Building Finish - Cladding and Red Brick

Figure 26: Overton Control Building Finish - Red Brick

Figure 28: Overton Control Building Finish - Grey Cladding

Figure 27: Overton Control Building Finish - Green Cladding

Acoustic enclosures

4.1.22 There is scope for variation in the colour finish of the SGT and shunt reaction acoustic enclosures. These may be RAL 6003 Olive Green or RAL 7037 Grey.

Substation boundaries (fences, walls and gates)

4.1.23 The 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 2.4m 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, extending 3.4m above base level.

4.1.24 Regarding the materials/ finishes used for the fencing, all fencing at Overton will be galvanised steel.

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

4.1.26 There are no specific design guidelines for fencing and gates on National Grid-owned land outside of the substation compound. However, it is important that any fencing or gates are suitable for the surrounding landscape and are in keeping with the aesthetic of the area.

Substation roads, footpaths and other surfacing

4.1.27 In general, the requirement for substation surfacing is that they should require little to no maintenance.

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

4.1.29 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application include parking spaces. The number of spaces is judged on a site by site basis.

4.1.30 For the external access road, the DCO application documents show an impermeable tarmac surface. There is scope for variation in the detailed design for the access roads. Alternatively, the roads could be concrete surface, a stone paved road in grey or red, or a permeable solution such as truck grid.

Figure 29: Truck Grid (Source: GrassMats Ltd)

Figure 33: Truck Cell (Source: abg geosynthetics)

Figure 30: Security Fence (Source: MMD Site Visit)

Figure 31: Impermeable Tarmac Road (Source: Swift surfacing)

Figure 32: Block Paving (Source: MM Site Visit)

Figure 34: Green DNO Building (Source: Integral Utility Services)

Substation landscape mitigation

4.1.31 New Planting detailed on the Outline Landscape Mitigation Strategy will also contribute to Biodiversity Net Gain (BNG). The mitigation proposals and design objectives are set out at paragraphs 3.4.10 to 3.4.11 in **ES Chapter 3 Description of the Project (Document 5.2.30) [APP-075]** and are illustrated on the **Outline Landscape Mitigation Strategy Figure 3.10, (Document 5.4.3(CB)) [REP2-031AS-017].**

4.1.32 The evolving scheme design including mitigation earthworks and planting were discussed in three online meetings with the Landscape and Planning Officers of the Joint Authorities, with the minutes set out in **Document 5.3.6B [APP-109]**. Mitigation was covered at all three meetings, and the final Meeting #3 summarises the discussion related to the earthworks and new planting around the Overton and Monk Fryston substations.

4.1.33 The location of earth mounding and tree planting in the Outline Landscape Mitigation Strategy reflects technical constraints including overhead line easements and maintenance access to the perimeter of the substation and pylons. Consideration was given to minimising the loss of BMV agricultural land and to the feasibility of farming the remaining arable agricultural land.

4.1.34 The dimensions of the proposed earth mounding as currently designed would accommodate all of the excess material generated from the substation works. A reduction in mound height and/or footprint would likely result in a surplus of excavated material and less than optimal solutions for disposal. These alternative options are likely to be subject to certification, licences or exceptions. Section 1.10 of the Outline Soil Management Plan **(Document 5.3.3E(B)) [REP2-022APP-098]** describes the potential alternative options include spreading the soil on adjacent fields, selling the soil, or diverting the soil to another development project or to landfill.

4.1.35 The profile of the mounding is flexible to some degree although it was considered that a maximum height of 3m above existing ground levels (up to 2m alongside the A19) with 1 in 3 outer slopes would be appropriate in the context of the steeper and taller embankment to the Overton Road bridge crossing the railway. A potential variation with lower-level mounding would be less effective in mitigating the new substation infrastructure from key receptors. The adoption of shallower earthwork slopes is not considered necessary as the 1 in 3 slopes would be largely disguised with woodland cover. In addition, if maintaining the currently proposed height of the earthworks, shallower slopes would require a larger footprint and subsequent greater loss of BMV agricultural land. In places where the earthworks footprint is restricted by infrastructure easements and maintenance access, shallower slopes would result in a reduced width for tree planting and lower earthworks height, both of which would be less effective in mitigating the new substation infrastructure from surrounding landscape and visual receptors.

4.1.36 Service easements limit the scope of variation and include the 400 kV YN OHL crossing the A19 and further southeast where the maintenance access track from the A19 near Hurns Gutter crosses a proposed Yorkshire Water pipeline. The associated easement prevents the extension of earth mounding and tree planting to form a continuous belt of planting along the A19.There must be a sufficient area surrounding the new overhead line that excludes high level planting and bunding to avoid impacting on safety clearances for the overhead line. There is also a required stand off, to be agreed with Yorkshire Water to avoid impacting on the water main.

Monk Fryston 275kV/400kV

4.1.37 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 detailed design. In summary the areas where there is scope for variation are:

- location based on the limits of deviation;
- the external finish of substation buildings and acoustic enclosures;
- the boundary treatments and surfacing; and
- the landscape mitigation proposals.

Substation limits of deviation (LoD) and Parameters

4.1.38 Monk Fryston substation is subject to the limits of deviation as described in Article 5(4) of the **draft DCO (Document 3.1(D~~B~~)) ~~[AS-011]~~** and as shown on Section F of the **Work Plan (Document 2.6.6(B)) [REP1-009]**. There are no lateral limits of deviation at Monk Fryston Substation.

4.1.39 Monk Fryston Substation is also subject to parameters set out in the Design Drawings **(Document 2.15(B))** which specifies where within the substation footprint, certain equipment can be located, and specifies the maximum height of the equipment.

Design Principles

Size and layout of substation compound

4.1.40 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 in it, protect the equipment in the substation and allow safe access to install, maintain, remove all or part of the substation. These design requirements and the dimensions of the electrical equipment determine the overall size of the substation. Refer to Parameter Plan DCO_DE/PS/15_01 within **Design Drawings (Document 2.15(B))**.

Separation between electrical equipment

4.1.41 The requirements National Grid adheres to set out the basic dimensions 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”.

4.1.42 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 design their systems so that no more than one part of the system needs to be switched off for any work to be done on it.

4.1.43 Generally the distance required between equipment, and between 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.

4.1.44 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.

Arrangement of the substation

4.1.45 As shown in the illustration in Section 3.0, the new Monk Fryston Substation will be located adjacent to the existing Monk Fryston substation containing the 400kV and 275kV parts. 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).

4.1.46 At Monk Fryston Substation, the proposed 400kV overhead line approaches from the east and has dictated the position of the 400kV part of the substation. Similarly, the 275kV overhead lines exit the substation at the west and have dictated the positioning of the 275kV part. The design of the substation has evolved through the design process, however the design has been heavily influenced by the existing substation and being able to connect into the existing infrastructure, reducing the amount of new infrastructure needed.

4.1.47 In general, the buildings are positioned where there is space and so as not to increase the overall footprint of the substation.

Electrical equipment

4.1.48 The electrical equipment required to operate the substation is governed by standards and type tests which confirm a product meets strength and capability requirements.

4.1.49 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.

Scope for Variation

4.1.50 The following sections set out where there is and isn’t scope for variation of the design and how elements for the substation will look. The areas where there is no scope for variation are due to equipment required to meet technical and safety standards. Where there is scope for variation in the design, this document sets out what the scope for variation is.

Finished Site Level

4.1.51 The existing site at Monk Fryston slopes from north to south. To match the existing site, the new site must slope from northeast to southwest with a level difference of approximately 3m (+35 to +38m AOD). This slope will avoid a significant “step” between existing and new site levels, which would make delivery of equipment unfeasible.

4.1.52 The site finish level is shown in the Monk Fryston Substation Elevation drawing DCO_DE/PS/15_03 within the **Design Drawings (Document 2.15(B)).** The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the substation must be built within a maximum of 15m above the finished site level.

Substation buildings

4.1.53 For the control buildings, there is some scope for variation in the external finishes. The buildings could be cladd, red brick, or a combination of the two.

4.1.54 For the Northern PowerGrid (Yorkshire) Plc Substation building, prefabricated buildings are generally preferred. This gives programme and safety benefits. For example, the finishes can be applied in a controlled environment and the construction time on a substation can be reduced.

4.1.55 The smaller buildings will typically be prefabricated, fibreglass or steel containers. The preferred colour is RAL 6003 Olive Green, although RAL 7037 Grey may be considered.

4.1.56 The existing workshop that is to be relocated will remain in whiteFor 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 made by the local authority, 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

4.1.564.1.57 The following figures show the Monk Fryston control building with the range of acceptable finishes.

Figure 35: Monk Fryston Control Building Finish - Cladding and Red Brick

Figure 36: Monk Fryston Control Building Finish - Red Brick

Figure 37: Monk Fryston Control Building Finish - Grey Cladding

Figure 38: Monk Fryston Control Building Finish - Green Cladding

Acoustic enclosures

~~4.1.57~~4.1.58 There is scope for variation in the colour finish of the SGT and shunt reaction acoustic enclosures. These may be RAL 6003 Olive Green or RAL 7037 Grey.

Substation boundaries (fences, walls and gates)

~~4.1.58~~4.1.59 The 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 2.4m 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, extending 3.4m above base level.

~~4.1.59~~4.1.60 Regarding the materials/ finishes used for the fencing, all fencing at Monk Fryston will be galvanised steel~~fencing in the North of the site, that is visible from Rawfield Lane would be green. All remaining fencing would be galvanised steel~~.

~~4.1.60~~4.1.61 The vehicle gates to the substation compound should match the heights and specification as the boundary treatments.

~~4.1.61~~4.1.62 There are no specific design guidelines for fencing and gates on National Grid-owned land outside of the substation compound. However, it is important that any fencing or gates are suitable for the surrounding landscape and are in keeping with the aesthetic of the area.

Substation roads, footpaths and other surfacing

~~4.1.62~~4.1.63 In general, the requirement for substation surfacing is that they should require little to no maintenance.

~~4.1.63~~4.1.64 To ensure proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

~~4.1.64~~4.1.65 During the operation of the substation, permanent vehicle access is necessary, and parking spaces should be available. The drawings included in the DCO application include parking spaces. The number of spaces is judged on a site by site basis.

~~4.1.65~~4.1.66 For the external access road, the DCO application documents show an impermeable tarmac surface. There is scope for variation in the detailed design for the access roads. Alternatively, the roads could be concrete surface, a stone paved road in grey or red, or a permeable solution such as truck grid.

Substation mitigation planting and landform

~~4.1.66~~4.1.67 New Planting detailed on the Outline Landscape Mitigation Strategy will also contribute to Biodiversity Net Gain (BNG). The mitigation proposals and design objectives are set out at paragraphs 3.4.27 to 3.4.29 in **ES Chapter 3 Description of the Project (Document 5.2.3) [APP-075]**, and are illustrated on the Outline Landscape Mitigation Strategy Figure 3.12, **(Document 5.4.3(C~~B~~)) [AS-017]**.

~~4.1.67~~4.1.68 The evolving scheme design including mitigation earthworks and planting were discussed in three online meetings with the Landscape and Planning Officers of the Joint Authorities, with the minutes set out in **Document 5.3.6B [APP-109]**. Mitigation was covered at all three meetings, noting that the final Meeting #3 summarises the discussion related to the earthworks and new planting around the Overton and Monk Fryston substations.

~~4.1.68~~4.1.69 The location of earth mounding and tree planting in the Outline Landscape Mitigation Strategy reflects technical constraints including overhead line easements and maintenance access to the perimeter of the substation and pylons. Consideration was given to minimising the loss of BMV agricultural land and to the feasibility of farming remaining and restored arable agricultural land.

~~4.1.69~~4.1.70 The Outline Landscape Mitigation Strategy reflects the location of the consented battery storage scheme and associated access road (Ref 2021/0633/FULM) which partially restricts the extent of any earthworks and planting mitigation to the south of the Proposed Substation. The Order Limits includes the existing woodland belt to the south of the substation, the management of which is secured under Requirement 8©.

~~4.1.70~~4.1.71 The dimensions of the proposed earth mounding as currently designed would accommodate all of the excess material generated from the substation works. A reduction in mound height and/or footprint would likely result in a surplus of excavated material and less than optimal solutions for disposal. These alternative options are likely to be subject to certification, licences or exceptions. Section 1.10 of the Outline Soil Management Plan **(Document 5.3.3E(B))** **[REP2-022~~APP-098~~]** describes the potential alternative options include spreading the soil on adjacent fields, selling the soil, or diverting the soil to another development project or to landfill.

~~4.1.71~~4.1.72 The profile of the mounding is flexible to some degree although it was considered that a maximum height of 3.5m above existing ground levels with 1 in 3 outer slopes would be appropriate in the context of the gently rolling landscape with significant woodland cover, noting taller and steeper mounding (grass seeded only) exists along the northern edge of the Monk Fryston substation. Potential variation with taller mounding and/or steeper slopes to reduce the loss of BMV land would have the potential to appear incongruous. A potential variation with lower-level mounding would be less effective in mitigating the new substation infrastructure from key receptors. The adoption of shallower earthwork slopes is not considered necessary as the 1 in 3 slopes would be largely disguised with woodland cover. In addition, if maintaining the currently proposed height of the earthworks, shallower slopes would require a larger footprint and subsequent greater loss of BMV agricultural land. In places where the earthworks footprint is restricted by infrastructure easements and maintenance access, shallower slopes would result in a reduced width for tree planting and lower earthworks height, both of which would be less effective in mitigating the new substation infrastructure from surrounding landscape and visual receptors.

Osbaldwick 400kV

~~4.1.72~~4.1.73 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 detailed design. In summary the areas where there is scope for variation are:

- location based on the limits of deviation;

- the external finish of substation buildings and acoustic enclosures;
- the boundary treatments and surfacing; and
- the landscape mitigation proposals.

Substation limits of deviation (LoD) and Parameters

4.1.734.1.74 Osbaldwick substation is subject to the limits of deviation as described in Article 5(4) of the **draft DCO (Document 3.1(DB))** **[AS-011]** and as shown on Section A of the **Work Plan (Document 2.6.1(B)) [REP1-004].** There are no lateral limits of deviation at Osbaldwick Substation.

4.1.744.1.75 Osbaldwick Substation is also subject to parameters set out in the Design Drawings **(Document 2.15(B))** which specifies where within the substation footprint, certain equipment can be located, and specifies the maximum height of the equipment

Design Principles

Size and layout of substation compound

4.1.754.1.76 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 in it, protect the equipment in the substation and allow safe access to install, maintain, remove all or part of the substation. These design requirements and the dimensions of the electrical equipment determine the overall size of the substation. Refer to Design Drawing Parameter Plan (Document (2.15(B) DCO_DE/PS/16_01).

Separation between electrical equipment

4.1.764.1.77 The requirements National Grid adheres to set out the basic dimensions 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”.

4.1.774.1.78 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 design their systems so that no more than one part of the system needs to be switched off for any work to be done on it.

4.1.784.1.79 Generally, the distance required between equipment, and between 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.

4.1.794.1.80 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.

Arrangement of the substation

4.1.80 4.1.81 As shown in the illustration in Section 3.0, Osbaldwick Substation works consists of a 400kV bay consisting of an overhead line gantry, 400kV circuit breaker and 400kV disconnectors. The works are contained within the existing Osbaldwick substation.

Electrical equipment

4.1.81 4.1.82 The electrical equipment required to operate the substation is governed by standards and type tests which confirm a product meets strength and capability requirements.

4.1.82 4.1.83 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.

Scope for Variation

4.1.83 4.1.84 The following sections set out where there is and isn't scope for variation of the design and how elements for the substation will look. The areas where there is no scope for variation are due to equipment required to meet technical and safety standards. Where there is scope for variation in the design, this document sets out what the scope for variation is.

Finished Site Level

4.1.84 4.1.85 The site finish level is shown in the Overton Substation Elevation drawing DCO_DE/PS/16_03 within the **Design Drawings (Document 2.15(B)).** The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the substation must be built within a maximum of 15m above the finished site level.

Substation roads, footpaths and other surfacing

4.1.85 4.1.86 In general, the requirement for substation surfacing is that they should require little to no maintenance.

4.1.86 4.1.87 To ensure proper functioning and safety of electrical equipment, the surfacing beneath and between the equipment must be made of clean, 75mm graded stone aggregate that is free-draining, interlocking, non-degrading, and has excellent electrical resistance.

4.1.87 4.1.88 The substation has existing fencing, roads and footpaths that are not being changed as a part of this project.

Substation mitigation planting

4.1.88 4.1.89 It was agreed with PINs that the likely landscape and visual effects from the changes proposed at the Osbaldwick Substation would be Not Significant and consequently it was scoped out of the LVIA, **Document 5.3.6A [APP-108].** The potential impact on trees along the northern boundary of the substation as illustrated in the AIA, **Document 5.3.3I(B) [REP4APP-010-012102-104]** will be assessed and should any reinstatement planting or specific management be required following completion of the final engineering design, this would be covered by Requirements 8, 9 and 10.

4.2 CSE Compounds

Shipton North and South

4.2.1 This section sets out the design principles that led to the development of the cable sealing end compound layouts, and explains where there is scope for variation within the detailed design. In summary the areas where there is scope for variation are:

- location based on the limits of deviation;
- the boundary treatments and surfacing; and
- the landscape mitigation proposals.

Cable Sealing End Compound limits of deviation (LoD) and Parameters

4.2.2 Shipton North and South Cable Sealing End Compounds are subject to the limits of deviation as described in Article 5 of the **draft DCO (Document 3.1(DB)) [AS-011]** and as shown on Section B of the **Work Plan (Document 2.6.2(B)) [REP1-005].**

4.2.3 Shipton North and South Cable Sealing End Compounds are also subject to parameters set out in the Design Drawings **(Document 2.15(B))** which specifies where within the substation footprint, certain equipment can be located, and specifies the maximum height of the equipment.

Design Principles

Size and Layout of CSE Compounds

4.2.4 National Grid designs its CSE compounds according to a set of safety instructions, policies, standards and guidance notes based on international standards. A CSE compound layout is designed to protect staff working in it, protect the equipment in the CSE compound and allow safe access for maintenance. These design requirements and the dimensions of the electrical equipment determine the overall size of the CSE compound. Refer to North CSEC Parameter Plan DCO_DE/PS/17_01 and South CSEC Parameter Plan DCO_DE/PS/18_01 within **Design Drawings (Document 2.15(B)).**

4.2.5 Shipton North CSEC utilises an anchor block solution, which is used in situations where there is space constraints and a typical gantry solution cannot be adopted. Through design evolution, and discussions with the landowner at Shipton North, the design was amended to an anchor block solution, which enabled the CSEC to be closer to the pylon, to avoid impacts on a farm expansion.

4.2.6 Shipton South CSEC is designed to be a standard gantry solution, which is the preferred technical solution, as electrical clearances are easier to achieve and are better for future maintenance.

Separation between electrical equipment

4.2.7 The requirements National Grid adheres to set out the basic dimensions 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".

4.2.8 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 done on it.

4.2.9 Generally the distance required between equipment, and between 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.

4.2.10 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.

Arrangement of the CSE compounds

4.2.11 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. As stated above, Shipton North has been influenced to avoid the farm expansion, leading to the CSEC encompassing the pylon YR40.

Electrical Equipment

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

4.2.13 There is limited 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.

Scope for Variation

The following sections set out where there is and isn't scope for variation of the design and how elements for the CSEC will look. The areas where there is no scope for variation are due to equipment required to meet technical and safety standards. Where there is scope for variation in the design, this document sets out what the scope for variation is.

Finished Site Level

4.2.14 The site finish level for Shipton North CSE is 15m AOD and is shown in the Substation Elevation drawing DCO_DE/PS/17_03 within the **Design Drawings (Document 2.15(B)).** The site finish level for Shipton South CSE is 14.8m AOD and is shown in the Substation Elevation drawing DCO_DE/PS/18_03 within the **Design**

Drawings (Document 2.15) [APP-064]. The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the cable sealing end compounds must be built within a maximum of 15m above the finished site level.

CSE compound boundaries (fences, walls and gates)

4.2.15 The National Grid Technical specification states external CSEC perimeter fencing must be a minimum of category 2 fence system. Category 2 includes a fence with an overall height of 2.4m 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, extending 3.4m above base level.

4.2.16 Regarding the materials/ finishes used for the fencing, all fencing at Shipton will be galvanised steel.

4.2.17 The vehicle gates to the CSEC compound should match the heights and specification as the boundary treatments.

4.2.18 There are no specific design guidelines for fencing and gates on National Grid-owned land outside of the CSEC compound. However, it is important that any fencing or gates are suitable for the surrounding landscape and are in keeping with the aesthetic of the area.

CSE Compound Roads, footpaths and other surfacing

4.2.19 In general, the requirement for CSEC surfacing is that they should require little to no maintenance.

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

4.2.21 For the external access road, the DCO application documents show an impermeable tarmac surface. There is scope for variation in the detailed design for the access roads. Alternatively, the roads could be concrete surface, a stone paved road in grey or red, or a permeable solution such as truck grid.

CSE Compound Mitigation planting

4.2.22 The Shipton CSEC is not an area identified for additional mitigation planting over and above reinstatement planting. Reinstatement planting is secured under Requirement ~~8 (1)(a)~~10 in the **Draft DCO** ~~**[**~~**(Document 3.1(D))**~~**AS-019]**~~ by way of the scheme for ~~mitigation~~ replacement planting and details would be provided upon completion of the detailed engineering design to avoid abortive design work. The approach to reinstatement planting is set out in **Chapter 3 Description of the Development (Document 5.2.3) [APP-075]** at paragraphs 3.6.59 to 3.6.61 and explains that the majority of reinstatement planting would be at the same location apart from where it is not possible due to the infrastructure or associated easements and a suitable location would be found as close as possible to the original planting.

4.2.23 The growth of reinstatement hedgerow planting along Newlands Lane would be effective in limiting the majority of views of the CSEC from the closest receptors (walkers on the ORPA along Newlands Lane) but would not screen the additional pylons as demonstrated by comparing Viewpoint 9 photomontages at Year 1 and

Year 15 in Figures 6.39b and 6.39c of 5.4.6 (Part 5 of 15) of **ES Chapter 6 Landscape and Visual Figures (Document 5.4.6 Part 5 of 15) [APP-171]**. The rationale for not including additional tree planting within the hedgerow is that it would not be possible to eliminate localised significant effects from Newlands Lane as sections of the route lie within the easement of the overhead lines and consequently oblique views of the new taller pylons would be unavoidable. The full context is set out in Table 6G.32 of **Appendix 6G Visual Receptor Assessment (Document 5.3.6G) [APP-114]** where it is stated that *"Given the close proximity of the existing 400kV Norton to Osbaldwick (2TW/YR) overhead line to the ORPA and the isolated location of the ORPA (that is not well connected to the wider PRoW network), no specific landscape measures are proposed to address the visibility of the new structures associated with the Project CSECs".*

Tadcaster East and West

4.2.24 This section sets out the design principles that led to the development of the cable sealing end compound layouts, and explains where there is scope for variation within the detailed design. In summary the areas where there is scope for variation are:

- location based on the limits of deviation;
- the boundary treatments and surfacing; and
- the landscape mitigation proposals.

Cable Sealing End Compound limits of deviation (LoD) and Parameters

4.2.25 Tadcaster East and Tadcaster West Cable Sealing End Compounds are subject to the limits of deviation as described in Article 5 of **the draft DCO (Document 3.1(D~~B~~)) ~~[AS-011]~~** and as shown on Section D of the Work Plan (Document 2.6.6(B)).

4.2.26 Tadcaster East and Tadcaster West Cable Sealing End Compounds are also subject to parameters set out in the Design Drawings **(Document 2.15(B))** which specifies where within the substation footprint, certain equipment can be located, and specifies the maximum height of the equipment

Design Principles

Size and Layout of CSE Compounds

4.2.27 National Grid designs its CSE compounds according to a set of safety instructions, policies, standards and guidance notes based on international standards. A CSE compound layout is designed to protect staff working in it, protect the equipment in the CSE compound and allow safe access for maintenance. These design requirements and the dimensions of the electrical equipment determine the overall size of the CSE compound. Refer to Tadcaster West CSEC Parameter Plan DCO_DE/PS/19_01 and Tadcaster East CSEC Parameter Plan DCO_DE/PS/20_01 within **Design Drawings (Document 2.15(B)).**

4.2.28 Tadcaster East CSEC utilises an anchor block solution, which is used in situations where there are space constraints, and a typical gantry solution cannot be adopted. Through design evolution the design was amended to an anchor block solution, which enabled the CSEC to be closer to, and encompassing the pylon, to avoid a number of technical constraints in the area.

4.2.29 Tadcaster West CSEC is designed to be a standard gantry solution, which is the preferred technical solution, as electrical clearances are easier to achieve and are better for future maintenance.

Separation between electrical equipment

4.2.30 The requirements National Grid adheres to set out the basic dimensions 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”.

4.2.31 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 done on it.

4.2.32 Generally the distance required between equipment, and between 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.

4.2.33 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.

Arrangement of the CSE compounds

4.2.34 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. As stated above, Tadcaster East has been influenced to significant technical constraints, leading to the CSEC encompassing the pylon XC481.

Electrical Equipment

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

4.2.36 There is limited 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.

Scope for Variation

4.2.37 The following sections set out where there is and isn’t scope for variation of the design and how elements for the CSEC will look. The areas where there is no scope variation are due to equipment required to meet technical and safety standards.

Where there is scope for variation in the design, the document sets out what the scope for variation is.

Finished Site Level

4.2.38 The site finish level for Tadcaster West CSE is 49.3m AOD and is shown in the Cable Sealing End Compound Elevation drawing DCO_DE/PS/19_03 within the **Design Drawings (Document 2.15(B)).** The site finish level for Tadcaster East CSE is 49.95m AOD and is shown in the Cable Sealing End Compound Elevation drawing DCO_DE/PS/20_03 within the **Design Drawings (Document 2.15(B)).** The finished site level is the baseline from which the maximum height parameters are to be assessed against, and the cable sealing end compounds must be built within a maximum of 15m above the finished site level.

CSE compound boundaries (fences, walls and gates)

4.2.39 The National Grid Technical specification states external CSEC perimeter fencing must be a minimum of category 2 fence system. Category 2 includes a fence with an overall height of 2.4m 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, extending 3.4m above base level.

4.2.40 Regarding the materials/ finishes used for the fencing, all fencing at Tadcaster will be galvanised steel.

4.2.41 The vehicle gates to the CSEC compound should match the heights and specification as the boundary treatments.

4.2.42 There are no specific design guidelines for fencing and gates on National Grid-owned land outside of the CSEC compound. However, it is important that any fencing or gates are suitable for the surrounding landscape and are in keeping with the aesthetic of the area.

CSE Compound Roads, footpaths and other surfacing

4.2.43 In general, the requirement for substation surfacing is that they should require little to no maintenance.

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

4.2.45 For the external access road, the DCO application documents show an impermeable tarmac surface. There is scope for variation in the detailed design for the access roads. Alternatively, the roads could be concrete surface, a stone paved road in grey or red, or a permeable solution such as truck grid.

CSE Compound Mitigation planting and landform

4.2.46 The Tadcaster CSEC’s is an area identified for additional mitigation planting. New planting detailed on the Outline Landscape Mitigation Strategy will also contribute to Biodiversity Net Gain (BNG). The mitigation proposals and design objectives are set out at paragraphs 3.4.22 to 3.4.23 in ES Chapter 3 **(Document 5.2.30) [APP-075]**, and are illustrated in the Outline Landscape Mitigation Strategy in Figure 3.11 **(Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]**.

4.2.47 The evolving scheme design including mitigation earthworks and planting were discussed in three online meetings with the Landscape and Planning Officers of the Joint Authorities, with the minutes set out in **Document 5.3.6B [APP-109]**.

4.2.48 The location of 1:2 embankments to retain the eastern CSEC reflects the location of existing pylon XC481 and other technical constraints including the need for maintenance access between the embankment and the post and rail fence defining the boundary to the embankment to the A64 dual carriageway. As illustrated in the Outline Landscape Mitigation Strategy in Figure 3.11 **(Document 5.4.3(C~~B~~)) [REP2-031~~AS-017~~]** it is proposed to soften the appearance of these embankments with native scrub planting. The existing tree planting adjacent to the A64 embankment including a Christmas tree plantation southwest of the eastern CSEC would be removed to facilitate the underground cabling and other underground service installation. No replacement tree planting is possible in this area due to service easements, however a new native hedgerow can be accommodated along the Order Limits boundary with Highway Authority land.

4.2.49 The Outline Landscape Mitigation Strategy also illustrates a proposal to reinforce the existing hedgerow along the A659 and to restore an historic field boundary hedgerow north of the western CSEC.

4.2.50 Additional planting would be technically feasible within the current Order Limits but this would be at the expense of Best and Most Versatile Agricultural Land and such variation is assessed as unnecessary in order to mitigate any significant Landscape and Visual Effects.

5. Approach to Detailed Design

5.1 Overton Substation

5.1.1 Provided that the DCO (Development Consent Order) is approved, the subsequent section outlines the strategy for the detailed design of Overton Substation, allowing for flexibility in certain areas.

Buildings

5.1.2 The suggested approach for the detailed design of Overton Substation involves using a combination of cladding or red brick for the control building.

5.1.3 The DCO application shows a mono pitch roof for the control building, but consideration could be given to using dual-pitched roofs on National Grid's control buildings to maintain local aesthetics, roofing materials should match the colour of the roofs found locally.

5.1.4 For the smaller ancillary buildings or containers, modular steel units with a painted finish in colours such as RAL 6003 Olive Green or RAL 7037 Grey are recommended. These colours have been chosen to blend in with the surrounding landscape during both summer and winter months, thus reducing the perceived mass of the substation in views.

Acoustic enclosures

5.1.5 The coloured paint finish for the modular steel acoustic enclosures will also be applied using either RAL 6003 Olive Green or RAL 7037 Grey.

Boundaries (Fences, walls and gates)

5.1.6 The proposed fencing for securing the substation compounds would consist of 2.4m galvanised palisade fencing with an electric fence on top to a combined minimum height of 3.4m. The vehicle gates leading into the substation will match the fencing proposed.

Roads, footpaths and other surfacing

5.1.7 It is proposed to use stone aggregate for surfacing beneath and between electrical equipment at Overton Substation, which must meet National Grid's specification (as detailed in Section 3) and be locally sourced where possible. The use of different aggregate colours should be explored to create contrast with the majority of the electrical equipment and reduce the perceived mass of the substation when viewed from above. The colour of aggregate used should be grey but vary depending on locally sourced materials.

5.1.8 For vehicle access routes, parking, and turning spaces within the substation compound and Car Park, gravel, reinforced gravel, or grass should generally be used for surfacing. As mentioned in section 4, the roads could be tarmac, concrete, a stone paved road in grey or red, or a permeable solution such as truck grid.

Mitigation planting

5.1.9 The detailed landscape mitigation scheme would reflect the Outline Landscape Mitigation Strategy and would be developed from the fixed engineering design once all limits of deviation have been fixed and the earthworks design has been potentially updated.

5.1.10 A site survey of all hedgerows to be retained would be carried out to establish up to date requirements for reinforcement, including any incidence of Ash dieback, and the survey would also identify potential locations of new tree planting in accordance with the specification note on Figure 3.10 **(Document 5.4.3(C)) [REP2-031APP-164]** which identifies the existing hedgerows to be reinforced and trees planted within or adjacent to hedgerows at 10m centres, where services permit, noting the spacing indicates the average spacing and the precise spacing would reflect the tree species selected in a particular location and existing trees nearby. The detailed landscape mitigation design would also need to reflect the final locations of services, visibility splays and other technical constraints.

5.1.11 There would be opportunities for the Local Planning Authority to suggest any minor changes to the planting pallete and/or request minor changes to the earthworks and extent of planting subject to these changes being non-material and compatible with the detailed design of underground services and drainage and above ground easements related to infrastructure.

5.2 Monk Fryston Substation

5.2.1 Provided that the DCO (Development Consent Order) is approved, the subsequent section outlines the strategy for the detailed design of Monk Fryston Substation, allowing for flexibility in certain areas.

Buildings

5.2.2 The suggested approach for the detailed design of Monk Fryston Substation involves using a combination of cladding or red brick for the larger amenity and control modular buildings.

5.2.3 The DCO application shows a dual pitch roof for the control building, but consideration could be given to using mono-pitched roofs on National Grid's control buildings to maintain local aesthetics, roofing materials should match the colour of the roofs found locally.

5.2.4 For the smaller ancillary buildings or containers, modular steel units with a painted finish in colours such as RAL 6003 Olive Green or RAL 7037 Grey are recommended. These colours have been chosen to blend in with the surrounding landscape during both summer and winter months, thus reducing the perceived mass of the substation in views. ~~The existing workshop that is to be relocated will remain in white.~~

~~5.2.4~~5.2.5 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 made by the local authority, 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

Acoustic enclosures

~~5.2.5~~5.2.6 The coloured paint finish for the modular steel acoustic enclosures will also be applied using either RAL 6003 Olive Green or RAL 7037 Grey.

Boundaries (Fences, walls and gates)

~~5.2.6~~5.2.7 The proposed fencing for securing the substation compounds would consist of 2.4m galvanised palisade fencing with an electric fence on top to a combined minimum height of 3.4m. The vehicle gates leading into the substation will match the fencing proposed.

Roads, footpaths and other surfacing

~~5.2.7~~5.2.8 It is proposed to use stone aggregate for surfacing beneath and between electrical equipment at Monk Fryston Substation, which must meet National Grid's specification (as detailed in Section 3) and be locally sourced where possible. The use of different aggregate colours should be explored to create contrast with the majority of the electrical equipment and reduce the perceived mass of the substation when viewed from above. The colour of aggregate used should be grey but may vary depending on locally sourced materials.

~~5.2.8~~5.2.9 For vehicle access routes, parking, and turning spaces within the substation compound and Car Park, gravel, reinforced gravel, or grass should generally be used for surfacing. As mentioned in section 4, the roads could be tarmac, concrete, a stone paved road in grey or red, or a permeable solution such as truck grid.

Mitigation planting

~~5.2.9~~5.2.10 The detailed landscape mitigation scheme would reflect the Outline Landscape Mitigation Strategy and would be developed from the fixed engineering design.

~~5.2.10~~5.2.11 A site survey of all hedgerows to be retained would be carried out to establish up to date requirements for reinforcement, including any incidence of Ash dieback. The detailed landscape mitigation design would also need to reflect the final locations of services, visibility splays and other technical constraints.

There would be opportunities for the Local Planning Authority to suggest any minor changes to the planting pallete and/or request minor changes to the earthworks and extent of planting subject to these changes being non-material and compatible with the detailed design of underground services and drainage and above ground easements related to infrastructure.

5.3 Tadcaster CSECs

5.3.1 Provided that the DCO (Development Consent Order) is approved, the subsequent section outlines the strategy for the detailed design of Tadcaster Cable Sealing End, allowing for flexibility in certain areas.

Boundaries (Fences, walls and gates)

5.3.2 The proposed fencing for securing the substation compounds would consist of 2.4m palisade fencing with a galvanised finish along with an electric fence on top to a combined minimum height of 3.4m. The vehicle gates leading into the substation will match the fencing proposed.

Roads, footpaths and other surfacing

5.3.3 It is proposed to use stone aggregate for surfacing beneath and between electrical equipment at Tadcaster Cable Sealing End, which must meet National Grid's specification (as detailed in Section 3) and be locally sourced where possible. The use of different aggregate colours should be explored to create contrast with the majority of the electrical equipment and reduce the perceived mass of the substation when viewed from above. The colour of aggregate used should be grey but may vary depending on locally sourced materials.

5.3.4 For vehicle access routes, and turning spaces within the cable sealing end compound, gravel, reinforced gravel, or grass should generally be used for surfacing. As mentioned in section 4 the roads could be tarmac, concrete, a stone paved road in grey or red, or a permeable solution such as truck grid.

5.4 Shipton CSECs

5.4.1 Provided that the DCO (Development Consent Order) is approved, the subsequent section outlines the strategy for the detailed design of Shipton Cable Sealing End, allowing for flexibility in certain areas.

Boundaries (Fences, walls and gates)

5.4.2 The proposed fencing for securing the substation compounds would consist of 2.4m palisade fencing with a galvanised finish along with an electric fence on top to a combined minimum height of 3.4m. The vehicle gates leading into the substation will match the fencing proposed.

Roads, footpaths and other surfacing

5.4.3 It is proposed to use stone aggregate for surfacing beneath and between electrical equipment at Shipton Cable Sealing End, which must meet National Grid's specification (as detailed in Section 4) and be locally sourced where possible. The use of different aggregate colours should be explored to create contrast with the majority of the electrical equipment and reduce the perceived mass of the substation when viewed from above. The colour of aggregate used should be grey but may vary depending on locally sourced materials.

5.4.4 For vehicle access routes, and turning spaces within the cable sealing end compound, gravel, reinforced gravel, or grass should generally be used for surfacing. As mentioned in section 4 the roads could be tarmac, concrete, a stone paved road in grey or red, or a permeable solution such as truck grid.

Mitigation planting

5.4.5 As set out in detail in Section 4 above, the Shipton CSEC is not an area identified for additional mitigation planting over and above reinstatement planting. Reinstatement planting is secured under Requirement ~~8 (1)(a~~10) in the form of the scheme for ~~mitigation~~replacement planting in the **Draft DCO (Document 3.1(D))~~B) [AS-019]~~** and details would be provided upon completion of the detailed engineering design to avoid abortive design work.

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