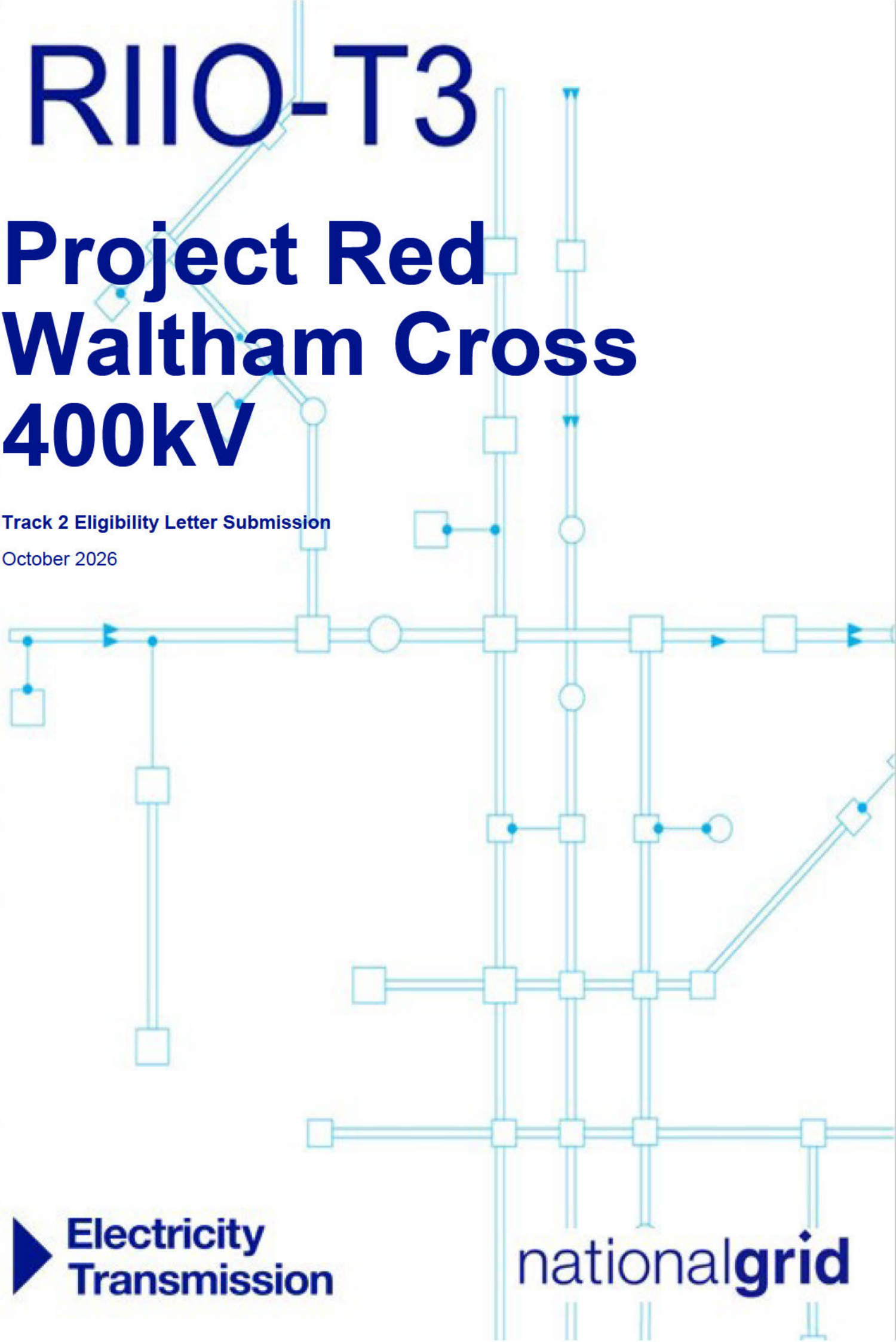
RIIO-T3

Project Red Waltham Cross 400kV

Track 2 Eligibility Letter Submission

October 2026



Electricity Transmission

nationalgrid

Contents

Reference and summary table iii

Executive summary v

1. Introduction 1

1.1 Project Red Waltham Cross 400kV [redacted] Data Centre 1
Eligibility, Project Track Statement and PASE 1
Preconstruction funding request 1

1.2 Background 2
Chronology of investment 2
Regional and network context 5
Site background 7
Historical funding 9
Early Asset Write Offs (EAWO) 9

2. Drivers and need case 10

2.1 Customer 10

2.2 Asset health 11

3. Optioneering 14

3.1 Strategic options 14

3.2 Siting 15

3.3 Longlist of options considered 15
Stakeholder influence on shortlisting 23

3.4 Shortlisted options 24
Description of short-list options considered 24

3.5 Qualitative assessment of shortlisted options 37
Qualitative assessment output 41
PASE alignment 41

3.6 Quantitative analysis of shortlist options 42
Cost estimates of shortlist options 42
Cost Benefit Analysis (CBA) 43

3.7 Preferred Overall Solution 48
Project benefits and outputs 48
Futureproofing 49

4. Delivery 50

4.1 Delivery year and indicative timeline 50

4.2 Procurement and contracting strategy 52

4.3 Risks and risk management 52

5. Conclusion **54**

Appendix A Glossary **A1**

Appendix B System Design Table **B1**

Appendix C Waltham Cross 275kV T1 and T2 asset interventions **C1**

Appendix D Layouts **D1**

List of Figures

Figure 1: Summary of chronology 4
Figure 2: Proposed location of Project Red Waltham Cross 400kV on our network 5
Figure 3: NGET's network map including Waltham Cross and other network upgrades 6
Figure 4: Aerial view of Waltham Cross substation 8
Figure 5: Close-up aerial view of Waltham Cross substation 8
Figure 6: Location of works 11
Figure 7: Option D-2A layout 26
Figure 8: Options D-2A to D-2E Single Line Diagram 27
Figure 9: Option D-2B layout 29
Figure 10: Option D-2C layout 31
Figure 11: Option D-2D layout 33
Figure 12: Option D-2E layout 35
Figure 13: Indicative programme of work for Project Red 51
Figure 14: Option E-1 layout D1
Figure 15: Option E-2 layout D2
Figure 16: Option E-3 layout D3

List of tables

Table 1: Summary of options vi
Table 2: Estimated costs for pre-construction activities (£m 23/24 prices) 2
Table 3: Interactive projects 7
Table 4: Investment drivers 10
Table 5: Details of customers with contracted connections 10
Table 6: Waltham Cross 275kV Asset Health Summary Table (2025/26 Asset Health Review) 12
Table 7: Waltham Cross 275kV T3 non-load asset health interventions 12
Table 8: Strategic direction setting 14
Table 9: Assessment of longlist options 16
Table 10: Summary of key differences among shortlisted options 36
Table 11: Multifactorial analysis 37
Table 12: Cost estimate breakdown 42
Table 13: Lifetime CBA (2023/24 prices, central carbon pricing, discounted values) 45
Table 14: Summary of all additional Capex costs (2023/24 base prices) 46
Table 15: Summary of all benefits 47
Table 16: Summary of risks and mitigations 53
Table 17: Table of abbreviations and definitions A1
Table 18: System Design Table A1
Table 19: T1 and T2 asset interventions C1

Reference and summary table

Field	Description
Project name	Project Red Waltham Cross 400kV [redacted] Data Centre
TO's preferred re-opener track	Track 2 Eligibility Letter (EL)
RRP references	NGT500257, NGT500258
BPDT / Scheme reference number	N/A
Load Board reference	NGT500257, NGT500258
Investment driver(s)	**Customer connection:** The investment is driven by [redacted] demand connection.
Project outputs	[redacted] installed Super Grid Transformers (SGTs) that enable a [redacted] customer connection.
Short list of strategic options considered	Five main options were shortlisted for detailed analysis: • Option D-2A: Installing [redacted] SGTs within the southwest and southeast corners of the 275kV substation compound • Option D-2B: Installing [redacted] SGTs within the southeast and northwest corners of the 275kV substation compound • Option D-2C: Installing [redacted] SGTs within the southeast and northeast corners of the 275kV substation compound • Option D-2D: Installing [redacted] SGTs in the northwest Development Consent Order (DCO) approved area of the existing 400kV substation compound • Option D-2E: Installing [redacted] SGTs in the northeast and east parts of the 275kV substation compound
Preferred option and explanatory narrative on the rationale	The preferred option is Option D-2C because it provides the most balanced and deliverable outcome when assessed against the balanced scorecard criteria. Specifically, it emerges as a strong engineering and deliverability option, with space to separate the construction area, future use and the Hackney Waltham Cross Upgrade Programme (HWUP) decommissioning of the eastern half of the 275kV substation.
PASE alignment	The preferred option is considered PASE Variant-aligned under the Pre-Approval of Solution Engineering (PASE) Variant category for extensions to SF_6 free Gas Insulated Switchgear (GIS) Double Bus

Field	Description		
	Bar substations. The project uses [redacted] bay positions within the planned SF_6 free 400kV Double Bus Bar GIS substation being delivered through the HWUP scheme, avoiding the need for a separate standalone substation solution and supporting efficient use of planned infrastructure.		
Cost (23/24 prices)	Total project cost: [redacted] (including [redacted] risk and contingency in 2023/24 price base)		
Delivery year	[redacted]		
Applicable reporting tables	RRP 23/24, 24/25, 25/26		
Interactive projects	Project Red interacts with HWUP. HWUP is a critical enabling scheme for this project because Project Red depends on upstream enabling works, shared outages, substation access and commissioning dependencies across the wider HWUP programme.		
Historic funding interactions	No historic funding		
Spend apportionment	**T2 (FY 2022-2026):**	**T3 (FY 2027-2031):**	**T4+ (FY 2032- 2037+):**
	[redacted]	[redacted]	[redacted]

Executive summary

Project summary

Project Red Waltham Cross 400kV [redacted] Data Centre investment will enable a [redacted] demand connection for [redacted] data centre. By connecting into the planned Waltham Cross 400kV SF_6-free Gas Insulated Switchgear (GIS) substation, the preferred option uses [redacted] GIS bay positions within the SF_6 free Double Bus Bar substation being delivered through the Hackney Waltham Cross Upgrade Programme (HWUP) scheme, together with [redacted] Super Grid Transformers (SGTs) and associated 400kV, 132kV and Low Voltage (LV) equipment. This coordinated approach makes efficient use of planned transmission infrastructure, avoids the need for a separate standalone substation solution, supports timely customer connection and minimises avoidable additional land take and rework.

HWUP and Project Red: scope and funding boundary

HWUP and Project Red are separate, complementary investments. HWUP constructs and commissions the new 400kV SF_6-free GIS substation at Waltham Cross, including the [redacted] GIS bays serving the [redacted] connection, [redacted] The [redacted] GIS bays required for Project Red are customer-specific connection assets and are excluded from HWUP's funding request. These costs are instead recovered through Project Red. These costs are excluded from HWUP's funding request in its Project Assessment (PA) submission to Ofgem[1].

Submission purpose

We are seeking Ofgem's approval, under the Load Related Re Opener (Special Condition 3.18 of the RIIO-ET3 licence), to progress Project Red Waltham Cross 400kV [redacted] Data Centre as a Track 2 Eligibility Letter (EL) investment and approval of Pre Construction Funding (PCF).

Project need

The investment is load driven, with the proposed investment required to support the following:

- [redacted] Contracted customer connection requirement for [redacted] [redacted] data centre demand connection at Waltham Cross, with a [redacted] Available For Commercial Load (ACL). [redacted] will construct their own 132kV substation to connect into the Waltham Cross substation. [redacted]
- There was an additional contracted customer requirement for a tertiary connection from [redacted] however, it fell away when [redacted] submitted a Modification Application (Mod App) changing their requirement from a tertiary

[1] HWUP's Project Assessment submission highlights this in Tables 1.2 and 7.1, and Section 7.2, confirming that these costs *"do not form part of the requested allowance to deliver HWUP"* and that they will be *"funded through an alternative regulatory mechanism"*

connection to a full self-contained connection (data centre demand) with details explained in Section 1.2, Background.

Optioneering to date

We have undertaken a multi factor optioneering process to identify the most efficient solution to meet the identified need. We conducted a high-level assessment of strategic options (do nothing, market-based, whole-system, reuse or extension of existing assets, and new-build) to develop a longlist of potential options.

Note: [redacted] was initially one of the two investment drivers. Following [redacted] Modification Application in January 2025 and re-offer at [redacted] these options were not carried forward in our revised optioneering in 2025.

Further details are set out in Chronology of investment in Section 1.2.

Table 1: Summary of options

Option	Details	Drivers met	New site	AIS/ GIS	Shortlist	Preferred option
Option A	Do nothing counterfactual option	No	N/A	N/A	No	No
Option B	Market-based solution	No	N/A	N/A	No	No
Option C	Non-transmission, whole systems solutions	No	N/A	N/A	No	No
Option D-1	Installing [redacted] SGTs to connect [redacted] into the **existing** Waltham Cross 275kV substation	Yes	No	AIS	No	No
Option D-2A	Installing [redacted] SGTs within **the southwest and southeast corners** of the 275kV substation compound, connecting into the new 400kV GIS substation	Yes	No	GIS	Yes	No
Option D-2B	Installing [redacted] SGTs within the **southeast and northwest corners** of the 275kV substation compound, connecting into the new 400kV GIS substation	Yes	No	GIS	Yes	No
Option D-2C	Installing [redacted] SGTs within the **southeast and northeast corners** of the 275kV substation compound, connecting into the new 400kV GIS substation	Yes	No	GIS	Yes	Yes
Option D-2D	Installing [redacted] SGTs in the **northwest DCO approved area** of the existing 400kV substation compound, connecting into the new 400kV GIS substation	Yes	No	GIS	Yes	No

Option	Details	Drivers met	New site	AIS/ GIS	Shortlist	Preferred option
Option D-2E	Installing [redacted] SGTs in the **northeast and east parts** of the 275kV substation compound, connecting into the new 400kV GIS substation	Yes	No	GIS	Yes	No
Option E-1	Installing [redacted] to allow multiple 132kV customer connections with banked 132kV connections	Yes	No	GIS	No	No
Option E-2	Installing [redacted] to allow multiple 132kV customer connections with a new 132kV Air Insulated Switchgear (AIS) substation	Yes	Yes	AIS	No	No
Option E-3	Installing [redacted] to allow multiple 132kV customer connections with a new 132kV GIS substation	Yes	Yes	GIS	No	No

Options A (do nothing) and B (market-based solutions) were rejected because they would not deliver the physical transmission connection required for the [redacted] demand connection and would therefore not meet National Grid Electricity Transmission's (NGET's) licence obligation to provide a compliant customer connection.

Option C was rejected because the Distribution Network Operator (DNO) does not have spare capacity to accommodate [redacted] contracted [redacted] requirement. [redacted]

Option D-1 was not progressed because of engineering challenges (no spare bays, constrained cable routing on the western side of the 275kV, outages), increased interaction with HWUP and because the longer-term development strategy for Waltham Cross is based on transition from the existing 275kV infrastructure to the 400kV network.

Options E-1, E-2 and E-3 were rejected because:

- Waltham Cross is a physically constrained site, surrounded by protected wetlands, which makes it difficult to connect cables into the site;
- A new 132kV solution would require land to be created by decommissioning parts of the existing 275kV substation, creating a dependency on the HWUP programme and uncertainty around land availability, construction sequencing and delivery timescales; and
- The North London East / Hertfordshire region is experiencing growing demand, [redacted] This has triggered a new [redacted] connection node in the region - [redacted] – which is a scalable connection point. The predicted regional capacity requirements exceed what can be accommodated at Waltham Cross. While Waltham Cross maintains future optionality through the new 400kV GIS infrastructure, there is currently no identified or contracted requirement that justifies establishing a new multi-customer 132kV sub at this site, especially considering the connection timeframes

involved and the above-mentioned site constraints. Following this assessment, the remaining, Option D-2 was assessed which includes five transformer-location sub-options (Options D-2A to D-2E).

In identifying a shortlist of options for this site, we have considered:

- Ability to meet the customer connection requirement as per customer's expectations;
- Engineering feasibility and layout constraints;
- Land, consenting and environmental constraints;
- Economic and consumer value; and
- Programme risk associated with the ongoing construction of Waltham Cross 400kV GIS substation.

Option D-2C, the preferred option, is the selected design option at the selected site, supported by the optioneering assessment and the referenced layouts/Single Line Diagrams (SLDs) in Section 3, Optioneering. The preferred option is the paired use of the southeast and northeast corners of the 275kV substation, which provides [redacted] transformer locations capable of forming a single compound following 275kV decommissioning. Together, these provide the strongest overall balance of consumer value, deliverability, and planning and land certainty at this stage of project development.

[redacted]

Cost estimates

Based on the latest Cost Book (2023/24 prices) and early project estimates, the preferred option, Option D-2C, has an estimated total cost of [redacted] including risk and contingency. Pre Construction Funding of [redacted] is requested to progress surveys, planning and land activities, Front End Engineering Design (FEED), early enabling works, programme management and obtain third party services. Of the total project cost ([redacted], approximately [redacted] will be recovered through Connection Charges (i.e. will be borne by [redacted]) while the remaining [redacted] are infrastructure costs.

Indicative delivery programme

Project Red is currently expected to be delivered in [redacted] as per the revised ACL date and our current programme, that has been communicated to the customer.

This connection is being delivered in coordination with the Waltham Cross 400kV GIS substation delivered through the HWUP scheme. Final commissioning and energisation will depend on the 400kV GIS substation being delivered by HWUP coming into service. We are working closely with the HWUP programme team to manage the interfaces between the two schemes. We will provide a further update on the programme and delivery date as part of the Project Assessment submission.

1. Introduction

1.1 Project Red Waltham Cross 400kV [redacted] Data Centre

This submission, coupled with its Annexes and Cost Benefit Analysis (CBA), is made under the Load Re-Opener and Price Control Deliverable (Special Condition 3.18 of the RIIO-ET3 Licence) for the Project Red Waltham Cross 400kV [redacted] Data Centre investment.

The application seeks the following determinations from Ofgem:

- approval of project eligibility under the Load Re-Opener and Price Control Deliverable (Special Condition 3.18);
- agreement in principle to the preferred option based on the development completed to date, with the final scope and efficient costs to be confirmed at Project Assessment;
- confirmation that the project should proceed via Track 2 Eligibility Letter (EL) of the re-opener process; and
- approval of Pre Construction Funding (PCF) under Special Condition 3.15 (Pre Construction Funding Reopener, Price Control Deliverable).

This investment will be referred to as Project Red in the rest of the document.

Eligibility, Project Track Statement and PASE

The project qualifies under Special Condition 3.18 as a load-driven investment scheduled for delivery within the RIIO-ET3 period. The investment has no allowances provided in the current or historic price control periods.

The project cannot be funded under Special Condition 3.12 Demand Connections Volume Driver because:

- variance between the project's total cost ([redacted] and the Volume Driver allowance [redacted] exceeds NGET's £12.251m atypical threshold[2]; and
- total cost exceeds £40m.

Track 2 EL is appropriate as a single preferred option is set out.

This project is Pre-Approval of Solution Engineering (PASE) aligned. Further detail is provided in PASE alignment in Section 3.5.

Preconstruction funding request

Under Special Condition 3.15 of the Electricity Transmission licence, this investment qualifies for allowances equal to [redacted] or 8.2% of its total forecasted cost ([redacted] at the time of this Load Re-Opener Eligibility Letter submission).

[2] RIIO-3 Final Determinations – National Grid Electricity Transmission (NGET): https://www.ofgem.gov.uk/sites/default/files/2025-12/RIIO-3-Final-Determinations-NGET.pdf

Table 2 below summarises the activities covered by the application of these PCF allowances based on our current progress of PCF and Early Enabling Works (EEW) spend. The estimated pre-construction expenditure for Project Red is [redacted]

EEW and project design activities constitute most of the PCF request. EEW include addressing site specific deliverability challenges, [redacted]

This position will be updated as we continue to mature this investment and ultimately reconciled at Project Assessment stage of the re-opener.

We confirm that no PCF activity included in this submission has been funded through baseline allowances, other re openers, or alternative licence mechanisms.

Table 2: Estimated costs for pre-construction activities (£m 23/24 prices)

No	Description	Total forecast costs (£m)
1	Surveys	[redacted]
2	Planning consent approvals	[redacted]
3	Optioneering and Front End Engineering Design (FEED) development	[redacted]
4	Project design activities	[redacted]
5	Early enabling works	[redacted]
6	Stakeholder engagement and consultation activities	[redacted]
TOTAL		[redacted]

1.2 Background

Chronology of investment

In 2022, NGET received two customer connection applications relevant to the early development of Project Red.

[redacted] applied in February 2022 for a [redacted] connection to the tertiary winding of Waltham Cross [redacted] The customer requested a connection date of [redacted] however after assessment, an ACL date of [redacted] was offered instead. In January 2025, [redacted] submitted a Modification Application (Mod App) to change its technology from a [redacted] tertiary generation connection to a [redacted] full self-contained connection (for a data centre). This introduced network-security constraints at Waltham Cross and, due to the Mod App, resulted in [redacted] losing its position in the connection queue. [redacted] was subsequently offered a connection at [redacted]

consistent with the regional approach of accommodating wider 132kV demand growth at the new node.

Up to January 2025, our optioneering considered tertiary connection options to accommodate [redacted] alongside the other contracted customer at the site. Following [redacted] Mod App, we revisited the optioneering and removed [redacted] from consideration. [redacted] is therefore no longer a driver for this investment.

[redacted]

In July 2022, [redacted] applied for a [redacted] connection by choice, requesting a [redacted] connection for a new data centre at [redacted] requested an Available for Commercial Load date of [redacted]

After assessment, we proposed a connection through the new Waltham Cross 400kV Gas Insulated Switchgear (GIS) substation being delivered by Hackney Waltham Cross Upgrade (HWUP). In May 2023, [redacted] signed a contract with a connection date of [redacted]

It is important to note that while a new node has been triggered in the area to accommodate wider regional demand, [redacted] contracted [redacted] requirement was made directly at Waltham Cross, with a connection date earlier than what [redacted] can deliver ([redacted]). Connecting at Waltham Cross is therefore necessary to meet the contractual requirement.

The customer connections drivers and high-level optioneering considerations are provided in Figure 1.

Figure 1: Summary of chronology

Customer Connection Applications – 2022:

We received two customer connection applications in 2022 – [redacted] and [redacted]

In February 2022, [redacted] applied for a tertiary connection at Waltham Cross. In January 2025, they submitted a Mod App to change their requirement from a tertiary connection to a full self-contained connection (data centre demand), which resulted in ESNO losing its position in the connection queue at Waltham Cross. After our assessment, [redacted] were offered a connection at [redacted] instead, with an ACL date of 2033.

In July 2022, [redacted] applied for a [redacted] connection for its new Data Centre to be built at [redacted]. In May 2023, the customer signed a contract with connection (ACL) date of [redacted]. Subsequently, a revised connection date of 31st October 2029 has been communicated to the customer, and a revised contract has been issued.

Early Optioneering – 2024/2025:

Early optioneering considered lower-build or alternative solutions, including a 'do nothing' option, 'market-based' or 'non-transmission' solutions, use of the Waltham Cross 275kV substation, and new substation options.

Early optioneering had both customer drivers. We ruled out 'do nothing', market-based and non-transmission solutions because they could not provide the required customer connections. We then assessed options for connecting both customers at Waltham Cross, including use of the existing 275kV substation.

In January 2025, when [redacted] submitted a Mod App, the revised optioneering focused solely on [redacted] connection.

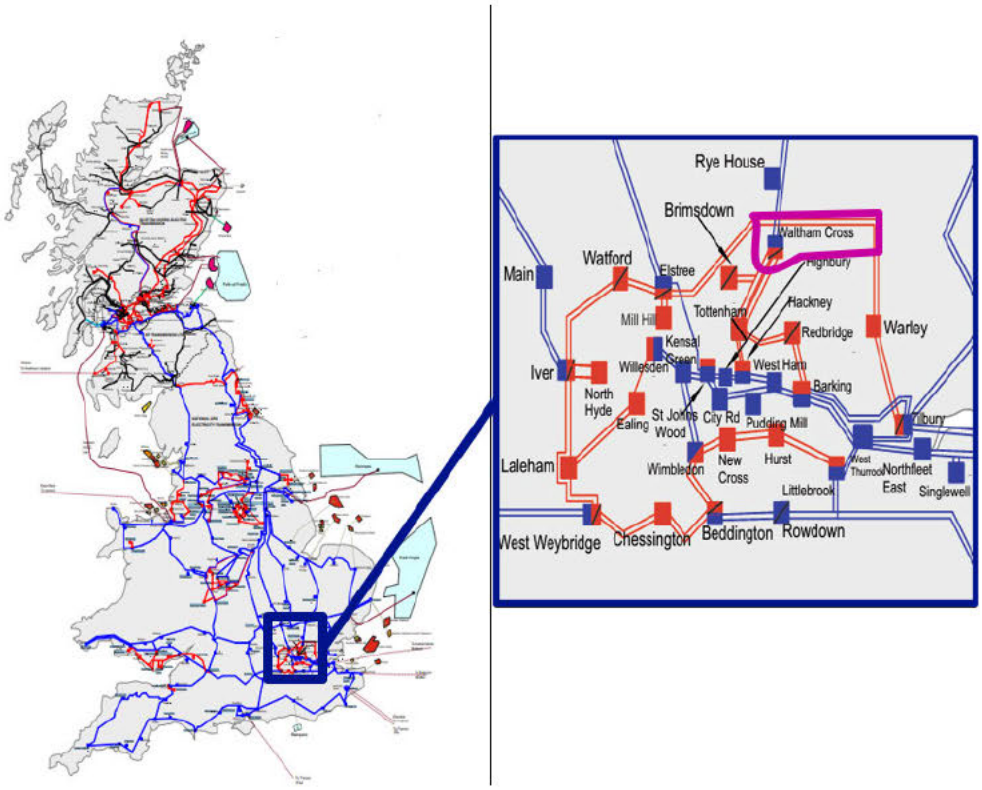
We assessed a range of options for [redacted] including connection to the new 400kV GIS substation being delivered through HWUP and new-build solutions.

Preferred option – 2026:

A connection into the new 400kV GIS substation and installation of [redacted] Super Grid Transformers (SGTs) within the existing 275kV substation has been through our standard optioneering process.

After exploring a range of options through our standard optioneering process, installation of [redacted] SGTs within the existing 275kV substation compound along with a connection into [redacted] bays within the new 400kV GIS substation has been identified as the preferred option. After exploring a range of options through our standard optioneering process, installation of [redacted] SGTs within the 275kV substation compound along with a connection into [redacted] bays within the new 400kV GIS substation has been identified as the preferred option.

Figure 2: Proposed location of Project Red Waltham Cross 400kV on our network



*Key: **Red** = 275kV assets, **Blue** = 400kV assets. Investment location shown in **pink** box.*

Regional and network context

Waltham Cross is an established transmission site serving the North London and Hertfordshire network, comprising existing 400kV and 275kV infrastructure. The existing 400kV substation is connected to the Rye House 1 and Pelham–Rye House 2 circuits, while the 275kV substation connects to the four Brimsdown–Tottenham circuits. The site is also crossed by the Elstree–Warley 275kV underground cable circuits.

North London is being shaped by strong demand growth linked to electrification and digital infrastructure. Key drivers include transport and heat electrification, major data centre developments and wider growth across London's urban economy. NGET's strategy in North London is to remove capacity constraints on existing routes and reinforce the network in a phased and coordinated way to support rising demand. During RIIO-ET3, this includes major upgrades on key outer London corridors, including conversion of important routes to 400kV operation and expansion of associated substations where required.

Significant and growing demand in the North East London / Hertfordshire region, including additional Distribution Network Operator (DNO) demand, has also triggered the establishment of a new 400/132kV node in the area. The new node, which is expected to be located on the [redacted] is also expected to act as an enabler for the [redacted] supporting a coordinated, 400kV-led development of the network in this region.

The regional network approach is to accommodate future 132kV demand through [redacted] and progress broader 400kV reinforcement of the North East London /

Hertfordshire area. Project Red is a customer-specific connection that aligns with this direction by connecting through the new Waltham Cross 400kV GIS infrastructure rather than creating a new 132kV demand hub at Waltham Cross.



HWUP Scheme:

Project Red forms part of a coordinated programme of reinforcement at Waltham Cross. The project has been intentionally designed to integrate with HWUP, which is delivering a new SF_6 free 400kV GIS substation. By utilising infrastructure already being delivered through HWUP, Project Red avoids duplication of assets and aligns with NGET's broader strategic objective of delivering coordinated reinforcement solutions which maximise the value of network investment. This approach reflects whole-system principles through integration of customer connection requirements with wider network development activities already underway at the site.

The new GIS substation includes 12 bays, of which [redacted] are required for Project Red. The design of the GIS substation will also allow for 6 spare bays. HWUP will decommission the eastern half of the existing 275 kV substation, creating additional development space and retaining spare GIS bay positions for future use. However, the availability of spare land and bays alone does not demonstrate that Waltham Cross can efficiently accommodate wider regional 132kV demand growth, which remains subject to physical site constraints, cable routing, access, environmental and consenting considerations. HWUP therefore improves future optionality at Waltham Cross but does not alter the current regional approach of accommodating wider 132kV demand growth through a separate, new node: [redacted]

HWUP is a critical enabler for Project Red. Energisation of the [redacted] SGTs for Project Red is dependent on multiple upstream enabling works on the HWUP scheme. Interaction with the HWUP schemes is primarily through shared outage windows, substation access, and commissioning dependencies across [redacted]

The HWUP programme includes several common outages and circuit reconfiguration activities required to upgrade the network and unlock downstream commissioning which affects Project Red. However, the scale of the HWUP programme, site constraints and interdependencies create programme coordination challenges at Waltham Cross, including potential impacts on the connection date for [redacted] HWUP is a complex transmission reinforcement project involving over 120 interdependent outages.

We will continue to coordinate with HWUP on system access to account for interactive outages, based on HWUP's revised outage plans and programme updates.

In addition to this, we have also made proactive project development choices to manage these interactions, i.e. reducing interactivity where it creates conflicts and making use of it where it offers deliverability efficiencies.

Table 3: Interactive projects

Project	Details	Status
HWUP	HWUP is a major infrastructure project to upgrade the transmission network across North London and Hertfordshire. It involves construction of a new 400kV GIS substation at Waltham Cross, replacement and reconfiguration of existing assets, and uprating of key circuits between Hackney, Brimsdown, Tottenham, Rye House and Stocking Pelham substations.	[redacted]

Site background

The proposed works are located at Waltham Cross, within and around the existing 400kV and 275kV substation environment. The site is located within a natural park and is surrounded by woodlands and waterways. There are ongoing works to extend the 400kV substation perimeter and construct a new GIS substation under HWUP. [redacted] Half of the 275kV site, Main 1, Reserve 1 and associated circuits, will be decommissioned as part of the HWUP scheme.

Waltham Cross 400kV Substation has [redacted] SGTs. [redacted] The low voltage side of these SGTs are connected to Waltham Cross 275kV Substation via cables or overhead connections. Waltham Cross 275kV Substation has [redacted] feeders. [redacted] There is no DNO demand at Waltham Cross and no tertiary connections currently in use. Elstree – Warley 1 & 2 Circuits (275kV) pass through the site, under the 400kV Substation, via cable. The Overhead Lines (OHLs) to Cable towers are immediately outside the substation perimeter.

Figure 4 and Figure 5 show aerial views of the Waltham Cross substation.

Figure 4: Aerial view of Waltham Cross substation



Figure 5: Close-up aerial view of Waltham Cross substation



Historical funding

Project Red is reported in Regulatory Reporting Pack (RRP) 23/24, RRP 24/25 and RRP 25/26 tables. However, no previous funding has been received from Ofgem for this investment driver.

Early Asset Write Offs (EAWO)

Our Fixed Asset Register indicates that we have carried out interventions on various assets within Waltham Cross 275kV substation during RIIO-ET1 and RIIO-ET2. An estimate of spend using our statutory Fixed Asset Register for these works is [redacted] (majority spend in RIIO-ET2), with an estimated remaining Regulated Asset Value (RAV) of [redacted]

2. Drivers and need case

The Project Red investment is triggered by a customer connection requirement in London. [redacted] has requested for a [redacted] connection for a data centre at [redacted]

NGET offered a connection at Waltham Cross to connect within the new 400kV substation being delivered by the HWUP scheme.

An ACL of [redacted] was requested but it could not be offered due to this date occurring before the 400kV substation would be completed. A connection (ACL) date of [redacted] was offered; however, a revised date of [redacted] has now been communicated to the customer, and a revised contract has been issued.

The customer ACL date presented in this submission reflects the modelled delivery programme. The testing and setting of ACL dates for customer contracts within scope of connections reform is ongoing throughout 2026. Confirmation of agreed ACL dates will therefore be presented in the next stage of submission.

Table 4: Investment drivers

Summary of drivers		ACL date
Demand Connection	[redacted] connecting at the Waltham Cross 400kV GIS substation	[redacted]

2.1 Customer

Table 5 provides an overview of customer connections, relative to this investment and the impacts of Connections Reform. A map showing customer locations is provided in Figure 6.

[redacted]

Table 5: Details of customers with contracted connections

Customer name	Project name	Technology type	Demand capacity	Transmission Entry Capacity	Voltage (kV)	ACL date	Connections Reform Gate / Phase
[redacted]	Project Red WALX40[redacted] Data Centre	Demand	[redacted]	N/A	[redacted]	[redacted]	Gate 2 – Phase 1

[redacted]

2.2 Asset health

[redacted]

[redacted]

[3] Please note that the asset health scoring is based on data that has been updated to reflect asset deterioration since the RIIO-T3 submission, which was based on 2023/24 asset condition data.

[4] In accordance with the decision-making framework set out in 'NGET_RIIO3_NGETQ10_Asset Health Decision Making', submitted as part of our RIIO-T3 Draft Determination response.



3. Optioneering

This section explains how we assessed the connection options for Project Red.

We have applied a staged, multi-factor optioneering process to identify the preferred option.

1. We start by determining the most suitable strategic option. Strategic optioneering determines the type of investment we should develop.
2. We then consider a longlist of technical options within each investment type, down selecting to a shortlist of options.
3. We then consider a shortlist of technical options, selecting a preferred option based on a qualitative balanced scorecard of considerations.
4. We then assess quantitatively all shortlisted options in a CBA to determine which technical option provides greater Net Present Value (NPV).
5. We then consider the outputs of both step 3 and 4 to provide a final preferred option.

3.1 Strategic options

In line with our standard optioneering process, we considered the following broad strategic options:

Table 8: Strategic direction setting

Option	Description
Option A: Do nothing	This option involves making no changes and therefore doing nothing to facilitate the connection of customers.
Option B: Market based solution	This option involves accommodating increased customer demand through the procurement and use of ancillary services only.
Option C: Non-transmission, whole systems solution	This option involves addressing the identified need without constructing new transmission assets, instead relying on coordinated interventions across the wider electricity system.
Option D: Make use of existing assets.	This option involves making use of existing infrastructure such as substations and could include extension or uprating
Option E: New substation	This option involves construction of a new substation

We discounted Options A, B and C due to the inability of these options to facilitate the connection requests.

Option E was ruled out on engineering, deliverability and consumer value grounds.

Therefore, Option D was the selected strategic option to utilise the existing and planned infrastructure at Waltham Cross.

A descriptive rationale for rejection or progression from the longlist is explained in Table 9.

3.2 Siting

As Strategic Option E would not meet the investment drivers, a new substation is not required, and a siting study is not applicable for this investment.

3.3 Longlist of options considered

In line with our internal processes and Ofgem's Load Re-Opener Guidance, we have undertaken a proportionate multifactorial assessment of the options to identify the option that offers the best overall outcome for consumers.

Table 9: Assessment of longlist options

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
Option A **Not progressed**	Do nothing	N/A	N/A	**Contractual and Licence compliance:** Compliant customer connection not delivered, and the option does not comply with our licence obligations to provide connections.
Option B **Not progressed**	Market based solution	N/A	N/A	**Contractual and Licence compliance:** Compliant customer connection not delivered, and the option does not comply with our licence obligations to provide connections.
Option C **Not progressed**	Non-transmission, whole systems solution	N/A	N/A	**Contractual and Licence compliance:** NGET considered whether whole-system measures, such as flexibility services, distribution network alternatives or wider network coordination, could meet the requirement without new transmission assets. These options may support network utilisation but would not provide the [redacted] transmission-connected demand capability required under the customer's connection agreement. [redacted] This option was therefore rejected because of the inability of the DNO to supply [redacted] with the required demand. This option would also not meet NGET's licence obligations for an enduring, compliant transmission connection.
Option D-1 **Not progressed**	Installing [redacted] SGTs to connect [redacted] into the existing Waltham	No drawing	N/A	**Engineering:** The Waltham Cross 275kV substation is to be decommissioned; first, the eastern half by [redacted] as part of the HWUP works and subsequently the western half which will be uprated to 400kV as part of a wider regional network reinforcement strategy. Whilst the western half of the 275kV substation will be

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
	Cross 275kV substation			retained temporarily, connecting the customer into it presents several engineering limitations. There are no spare bays in the west side of the 275kV substation, and creating the necessary connection infrastructure would require significant intervention within the retained section of the 275kV substation. At the same time, this location is significantly constrained, with limited space to accommodate new [redacted] SGTs and associated connection infrastructure. Integration of new assets would therefore require modifications within the existing operational substation, including construction and cable routing near live equipment. The retained western side is constrained by existing cables, services and operational equipment. This increases the complexity and safety risks associated with establishing viable cable routes for the new connection. **Deliverability:** A [redacted] connection would require additional outages, including outages affecting the interbus transformer arrangements, requiring close coordination with the wider HWUP programme and introducing additional outage, construction and sequencing interfaces. Thus, this option will depend on the reconfiguration and progressive decommissioning of the existing live 275kV substation, which would also interact and depend on the wider HWUP programme. The option would therefore introduce additional safety (live equipment) and delivery risks. This would render the contracted connection date unachievable. **Economic/consumer value:** The longer-term development strategy for Waltham Cross is based on transition from the existing 275kV infrastructure to the 400kV network. Establishing new [redacted] assets would therefore introduce infrastructure with a potentially limited operational life and a risk of early asset write-off as the 275kV network is progressively decommissioned. For these reasons, Option D-1 is not considered an efficient or economic enduring solution for consumers.
Option D-2A **Progressed to shortlist**	Installing [redacted] SGTs within the **southwest and**	Single Line Diagram (SLD) and layout	N/A	**Engineering:** Smallest space requirements and impact on existing scheme's layout.

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
	southeast corners of the 275kV substation compound, connecting into the new 400kV GIS substation	diagrams are provided in Section 3.4. Shortlisted options.		**Economic/Consumer Value:** Least amount of equipment required and reuse of existing bund space. It also maximises value from existing planned investments (HWUP) and saves additional cost to consumers. **Environmental:** Minimises additional land take and limits environmental impacts associated with additional construction.
Option D-2B **Progressed to shortlist**	Installing [redacted] SGTs within the **southeast and northwest** corner of the 275kV substation compound, connecting into the new 400kV GIS substation	SLD and layout diagrams are provided in Section 3.4. Shortlisted options.	N/A	**Engineering:** Smallest space requirements and impact on existing scheme's layout. **Economic/Consumer Value:** Least amount of equipment required and reuse of existing bund space. It also maximises value from existing planned investments (HWUP) and saves additional cost to consumers. **Environmental:** Minimises additional land take and limits environmental impacts associated with additional construction.
Option D-2C **Progressed to shortlist**	Installing [redacted] SGTs within the **southeast and northeast** corners of the 275kV substation compound, connecting into the new 400kV GIS substation	SLD and layout diagrams are provided in Section 3.4. Shortlisted options.	N/A	**Engineering:** Smallest space requirements and impact on existing scheme's layout. **Economic/Consumer Value:** Least amount of equipment required and reuse of existing bund space. Reuses a disconnected bay space northeast of the 275kV substation. It also maximises value from existing planned investments (HWUP) and saves additional cost to consumers. **Environmental:** Minimises additional land take and limits environmental impacts associated with additional construction.
Option D-2D **Progressed to shortlist**	Installing [redacted] SGTs in the **northwest DCO approved area** of the existing 400kV	SLD and layout diagrams are provided in Section 3.4.	N/A	**Engineering:** Smallest space requirements and impact on existing scheme's layout. **Economic/Consumer Value:** Least amount of equipment required. It also maximises value from existing planned investments (HWUP) and saves additional cost to consumers.

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
	substation compound, connecting into the new 400kV GIS substation	Shortlisted options.		**Environmental:** Minimises additional land take and limits environmental impacts associated with additional construction.
Option D-2E **Progressed to shortlist**	Installing [redacted] SGTs in the **northeast and east parts** of the 275kV substation compound, connecting into the new 400kV GIS substation	SLD and layout diagrams are provided in Section 3.4. Shortlisted options.	N/A	**Engineering:** Smallest space requirements and impact on existing scheme's layout. **Economic/Consumer Value:** Least amount of equipment required and reuse of disconnected bay space. It also maximises value from existing planned investments (HWUP) and saves additional cost to consumers. **Environmental:** Minimises additional land take and limits environmental impacts associated with additional construction.
Option E-1 **Not progressed**	Installing [redacted] SGT's to allow multiple 132kV customer connections with banked 132kV connections	Layout diagrams are provided in Appendix D	N/A	**Engineering:** The northwest side is constrained to enable cable routing. It must cross numerous existing cables and services, increasing routing difficulty and construction risk. Secondly, locating banked circuits in this area would be difficult, and the option offers limited flexibility to connect multiple future customers. **Deliverability:** This option would require land to be created by decommissioning parts of the existing 275kV substation, creating a dependency on the HWUP programme that would introduce uncertainty around land availability, construction sequencing and delivery timescales. The proposed HWUP overhead line route would further constrain a new 132kV solution within the available site area. **Economic/consumer value:** Growing demand in the North East London and Hertfordshire region, [redacted], has specifically triggered a new 400/132kV node in the area, to provide a scalable connection point for multiple future customers. While Waltham Cross retains capability to accommodate the contracted [redacted] connection and maintains future transmission optionality through the new 400kV GIS infrastructure, there is currently no identified or contracted requirement that justifies establishing a new multi-customer 132kV hub at Waltham Cross.

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
				Furthermore, Waltham Cross is a constrained legacy site with increasing construction, access and cable routing challenges which limits its potential to become a scalable 132kV solution. Therefore, establishing a new 132kV hub at Waltham Cross would duplicate functionality being provided through the new node without supporting the longer-term regional development pathway. The longer-term regional pathway is based on coordinated 400 kV reinforcement across North East London and Hertfordshire, with [redacted] acting as the principal scalable location for wider future 132 kV demand growth. Option E-1 would therefore increase costs and create additional delivery dependencies resulting in a delay and increased deliverability risk to [redacted] contracted connection.
Option E-2 **Not progressed**	Installing [redacted] SGT's to allow multiple 132kV customer connections with a new 132kV **AIS** substation	Layout diagrams are provided in Appendix D	Planning permission and SAB (SuDS) consent are required. Requires new land and new cable easement corridors. The power station site has minimal environmental constraints beyond potential contaminated land/remediation, while other (likely greenfield) locations would have greater	**Engineering:** Due to site constraints, a new 132kV solution would sit directly beneath the proposed HWUP overhead lines. Building beneath live overhead lines does not comply to our Safety by Design principles and Construction (Design and Management) Regulations, and these options are therefore presented for indicative purposes only. While moving the tower may help overcome this constraint, there is lack of physical space within the site that prevents it. In addition, HWUP are now in the construction phase. **Deliverability:** Sufficient land would need to be created through decommissioning parts of the existing 275kV substation, creating a dependency on the HWUP programme and introducing uncertainty around land availability, construction sequencing and delivery timescales. In addition, the proposed HWUP overhead line route would further constrain development of a new 132kV solution. Waltham Cross is a physically constrained site, surrounded by protected wetlands. The site's location makes it challenging for customers to secure viable cable routes into it. These constraints limit its potential to become a scalable 132kV solution. **Economic/consumer value:** Growing demand in the North East London and Hertfordshire region [redacted] has specifically triggered a new 400/132kV node in the area, to provide a scalable connection point for multiple future customers. While Waltham Cross retains capability to

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
			environmental impact.	accommodate the contracted [redacted] connection and maintains future transmission optionality through the new 400kV GIS infrastructure, there is currently no identified or contracted requirement that justifies establishing a new multi-customer 132kV hub at Waltham Cross. Therefore, establishing a new 132kV hub at Waltham Cross would duplicate functionality being provided through the new node without supporting the longer-term regional development pathway. The longer-term regional pathway is based on coordinated 400 kV reinforcement across North East London and Hertfordshire, with [redacted] acting as the principal scalable location for wider future 132 kV demand growth. Option E-2 would therefore increase costs and create additional delivery dependencies resulting in a delay and increased deliverability risk to [redacted] contracted connection.
Option E-3 **Not progressed**	Installing [redacted] SGT's to allow multiple 132kV customer connections with a new 132kV **GIS** substation	Layout diagrams are provided in Appendix D	Planning permission and SAB (SuDS) consent are required. Requires new land and new cable easement corridors; potential contaminated land/remediation. Other (likely greenfield) locations would have greater environmental impact.	**Engineering:** Due to site constraints, a new 132kV solution would sit directly beneath the proposed HWUP overhead lines. Building beneath live overhead lines does not comply with our Safety by Design principles and Construction (Design and Management) Regulations, and these options are therefore presented for indicative purposes only. **Environmental:** Potential greenbelt land requirement and contamination. **Deliverability:** Sufficient land would need to be created through decommissioning parts of the existing 275kV substation, creating a dependency on the HWUP programme and introducing uncertainty around land availability, construction sequencing and delivery timescales. In addition, the proposed HWUP overhead line route would further constrain development of a new 132kV solution. Waltham Cross is a physically constrained site, surrounded by protected wetlands. The site's location makes it challenging for customers to secure viable cable routes into it. These constraints limit its potential to become a scalable 132kV solution. **Economic/consumer value:** Growing demand in the North East London and Hertfordshire region, [redacted], has specifically triggered a new 400/132kV node in the area, to provide a scalable connection point for multiple future customers. While Waltham Cross retains capability to

Option	Technical Description	Relevant diagrams, layout or SLD reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
				accommodate the contracted [redacted] connection and maintains future transmission optionality through the new 400kV GIS infrastructure, there is currently no identified or contracted requirement that justifies establishing a new multi-customer 132kV hub at Waltham Cross. Therefore, establishing a new 132kV hub at Waltham Cross would duplicate functionality being provided through the new node without supporting the longer-term regional development pathway. The longer-term regional pathway is based on coordinated 400 kV reinforcement across North East London and Hertfordshire, with [redacted] acting as the principal scalable location for wider future 132 kV demand growth. Option E-3 would therefore increase costs and create additional delivery dependencies resulting in a delay and increased deliverability risk to [redacted] contracted connection.

Shortlisting rationale

To summarise, our shortlisting rationale was:

- We ruled out A, B and C on technical and licence compliance grounds because of their inability to facilitate connection requests.
- We ruled out D-1 on engineering, deliverability and futureproofing.
- We ruled out E-1 – E-3 on engineering, deliverability and consumer value grounds because they relied on land being released through 275kV decommissioning activities under HWUP, with further constraints arising from the proposed HWUP overhead line route. Furthermore, due to the Waltham Cross site being constrained, growing demand in the region is being accommodated by a new node: [redacted]

AIS / GIS considerations

The new 400kV substation being delivered through HWUP is an SF_6-free GIS substation. The ageing 275kV AIS substation is being decommissioned in line with the regional strategy to operate the area at 400kV.

The shortlisted options install [redacted] SGTs within the 275kV substation compound and connect [redacted] into the new 400kV GIS substation being delivered through HWUP. These options therefore do not involve a separate AIS/GIS technology choice as the switchgear technology is set by HWUP. An AIS-based approach was considered at longlist stage, either by connecting into the retained 275kV AIS environment (Option D-1) or by constructing a new AIS 132kV substation (Option E-2) but was discounted for the reasons set out in Table 9.

Stakeholder influence on shortlisting

The shortlisting for Project Red was driven principally by engineering deliverability, programme interfaces with HWUP, construction segregation and consumer value. The host 400kV GIS substation (HWUP) consulted with a range of stakeholders to develop the scheme, and it was consented through the National Grid (North London Reinforcement Project) 2014 Development Consent Order. That DCO was supported by a comprehensive, multi-stage community and statutory consultation programme (2011-2012), engaging statutory consultees (including [redacted]), the relevant local planning authorities, the [redacted], elected representatives, landowners and local communities. Stakeholder feedback during that process directly influenced design outcomes at Waltham Cross, including the adoption of a GIS solution and mitigation of impacts on the Lee Valley Regional Park.

Since Project Red connects into infrastructure delivered under HWUP's scheme, it benefits from the primary consent and stakeholder settlement already established for the site. Any external stakeholders did not influence the shortlist for this investment. Where stakeholder and consenting considerations were relevant (for example car-parking land and [redacted]), these are captured under the consenting/stakeholder criterion of the multifactorial assessment in Section 3.5, Qualitative assessment of shortlisted options. A summary of engagement with the relevant parties that are important in context of this investment's delivery is below:

HWUP programme and NGET site operations teams – ongoing coordination of shared outage windows, substation access, site establishment (construction compound, laydown and car-parking areas) and commissioning sequence.

[redacted]

3.4 Shortlisted options

Following assessment of the longlist against a defined set of criteria, we progressed the following five options to the shortlist:

- Option D-2A: Installing [redacted] SGTs within the southwest and southeast corner of the 275kV substation compound.
- Option D-2B: Installing [redacted] SGTs within the southeast and northwest corner of the 275kV substation compound.
- Option D-2C: Installing [redacted] SGTs within the southeast and northeast corners of the 275kV substation compound.
- Option D-2D: Installing [redacted] SGTs in the northwest DCO approved area of the existing 400kV substation compound.
- Option D-2E: Installing [redacted] SGTs in the northeast and east parts of the 275kV substation compound.

Description of short-list options considered

All five shortlisted options install [redacted] SGTs connected by 400kV cables to the planned GIS substation and by 132kV cables to the [redacted] Project Red circuits. [redacted] No additional control building is proposed, as the protection and control equipment is expected to be accommodated within the new GIS building. All options require coordination with the HWUP programme and the customer, together with new transformer bunds and cable-route excavations.

To satisfy the driver at minimum cost, it is necessary to undertake the following works for each of the [redacted] SGTs for the scheme. The [redacted] GIS bays will be required for all options and will be constructed by the HWUP scheme ready for this scheme to connect into:

New Transformer Development:

- Construction of a new [redacted] SGT to be connected to the 400kV substation via cable and the 132kV Project Red circuit.

- The bay will connect into the planned 400kV GIS substation and consist of:



Primary Plant and Buildings:

- No additional building is planned under this work as there is expected to be space within the new GIS building to house all protection and control elements.

Network Interfaces and Remote-End Works:

- Integration into the new 400kV substation being constructed is a primary interface of this scheme with dates and bay locations set by HWUP.
- Circuit end works will require co-ordination with the customer.

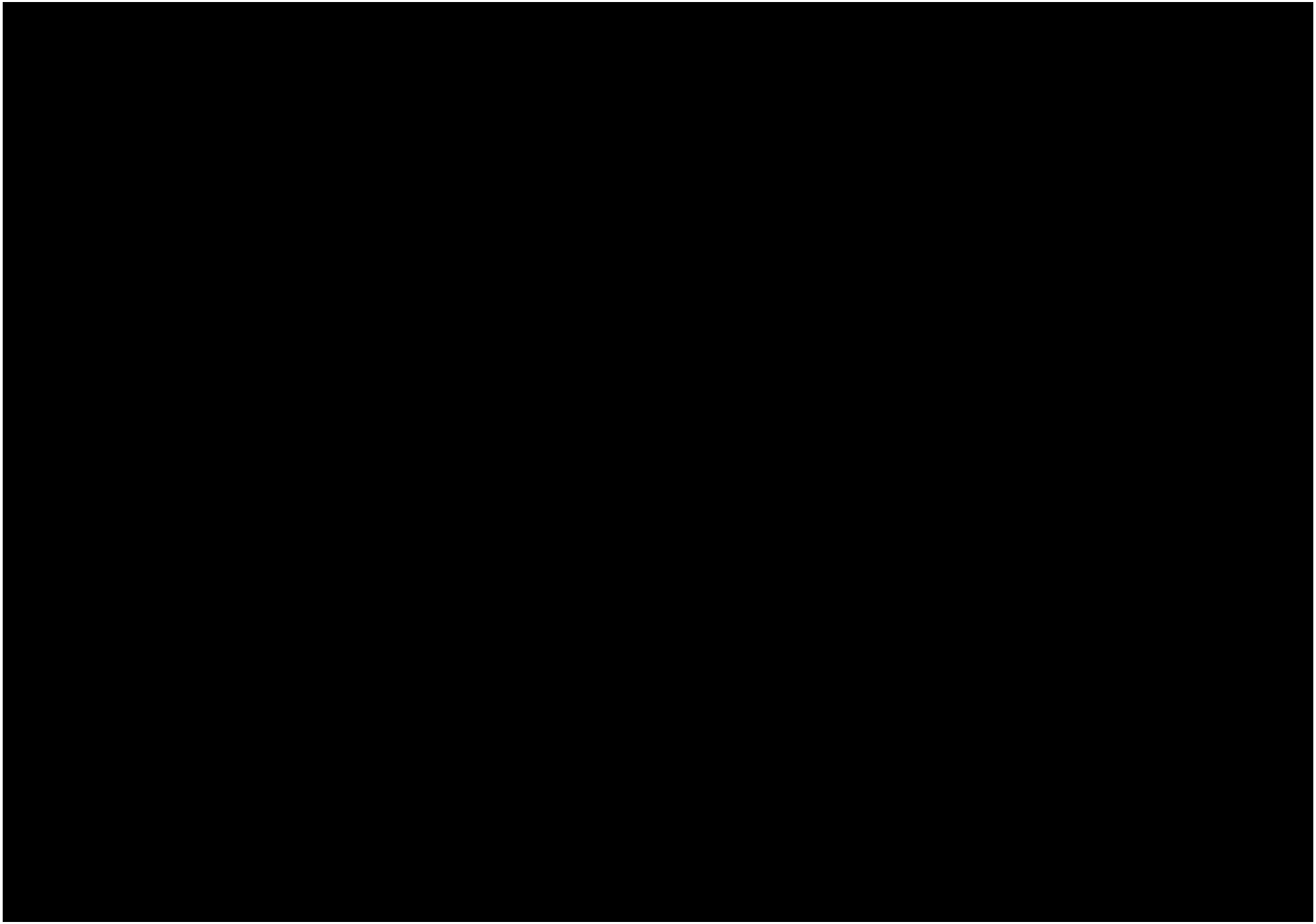
Civil, Access and External Works:

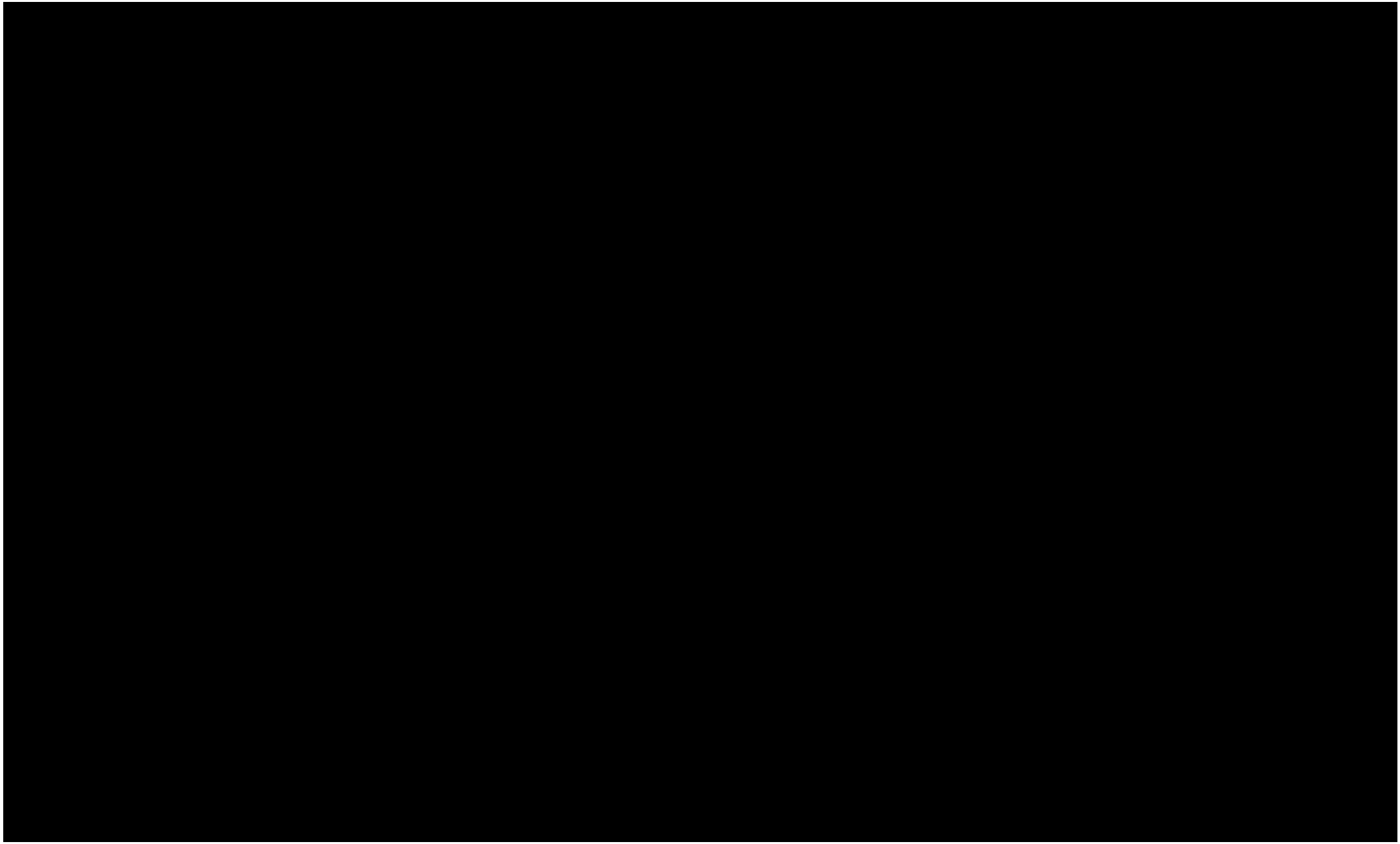
- Construction of new transformer bunds will be required.
- Excavation for the 400kV cable routes:

Option D-2A: Installing [redacted] within the southwest and southeast corner of the 275kV substation

Proposed works:

- Install [redacted] SGT in [redacted] the southwest and southeast corners of the 275kV substation, with associated 400kV and 132kV equipment, bunds and cable connections.
- The southwest 400kV cable would pass beneath the HWUP retaining wall, while the southeast route would cross the main services corridor. The existing spare transformers and bunds in the southeast area would be removed.
- Both locations have tight clearances with no current allowance for a demarcation fence. The southwest location also requires a longer 400kV cable route beneath the HWUP retaining wall, while the southeast location requires enabling works and a crossing of the main services corridor. These interfaces increase construction complexity and dependence on the HWUP programme.

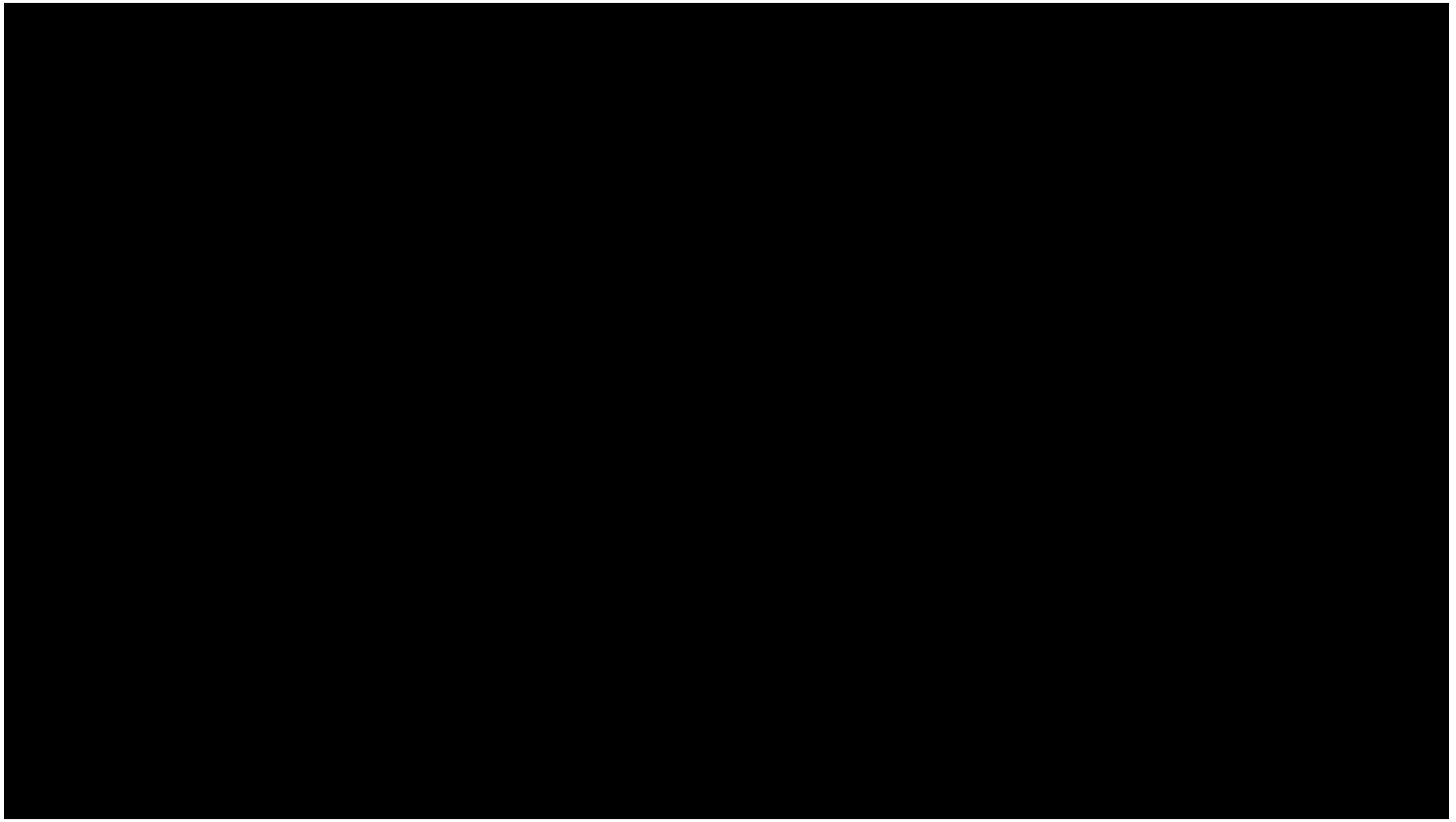




Option D-2B: Installing [redacted] SGTs within the southeast and northwest corner of the 275kV substation

Proposed works:

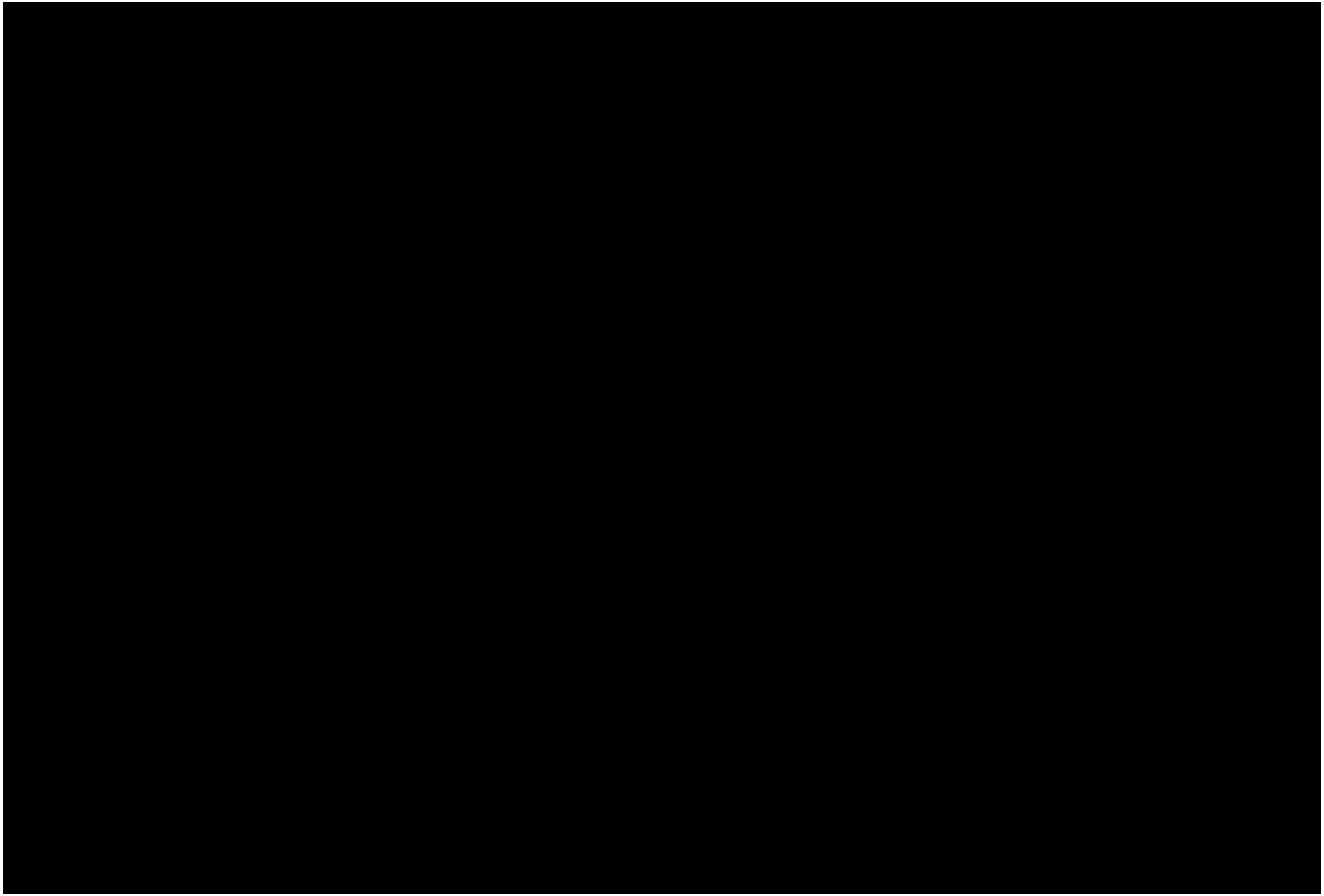
- Install [redacted] SGT in the southeast corner and [redacted] northwest corner of the 275kV substation, with associated equipment, bunds and cable connections.
- The southeast area has currently [redacted] spare transformers that have been marked for removal due to age. This area, like the southwest corner, has space to accommodate the SGT and equipment needed; however, design clearances (although met) are tight and leave no room for a demarcation fence.
- The northwest cable routes would pass beneath the HWUP retaining wall and cross the retained SGT2 circuit.
- The northwest area is surrounded on 3 sides by the existing substation that is not planned for decommissioning at this stage which is not an ideal long-term solution creating potential challenges for future maintenance or replacement works under fault conditions. Its 400kV and 132kV routes would also cross the retained SGT2 circuit.



Option D-2C: Installing [redacted] SGTs within the southeast and northeast corners of the 275kV substation

Proposed works:

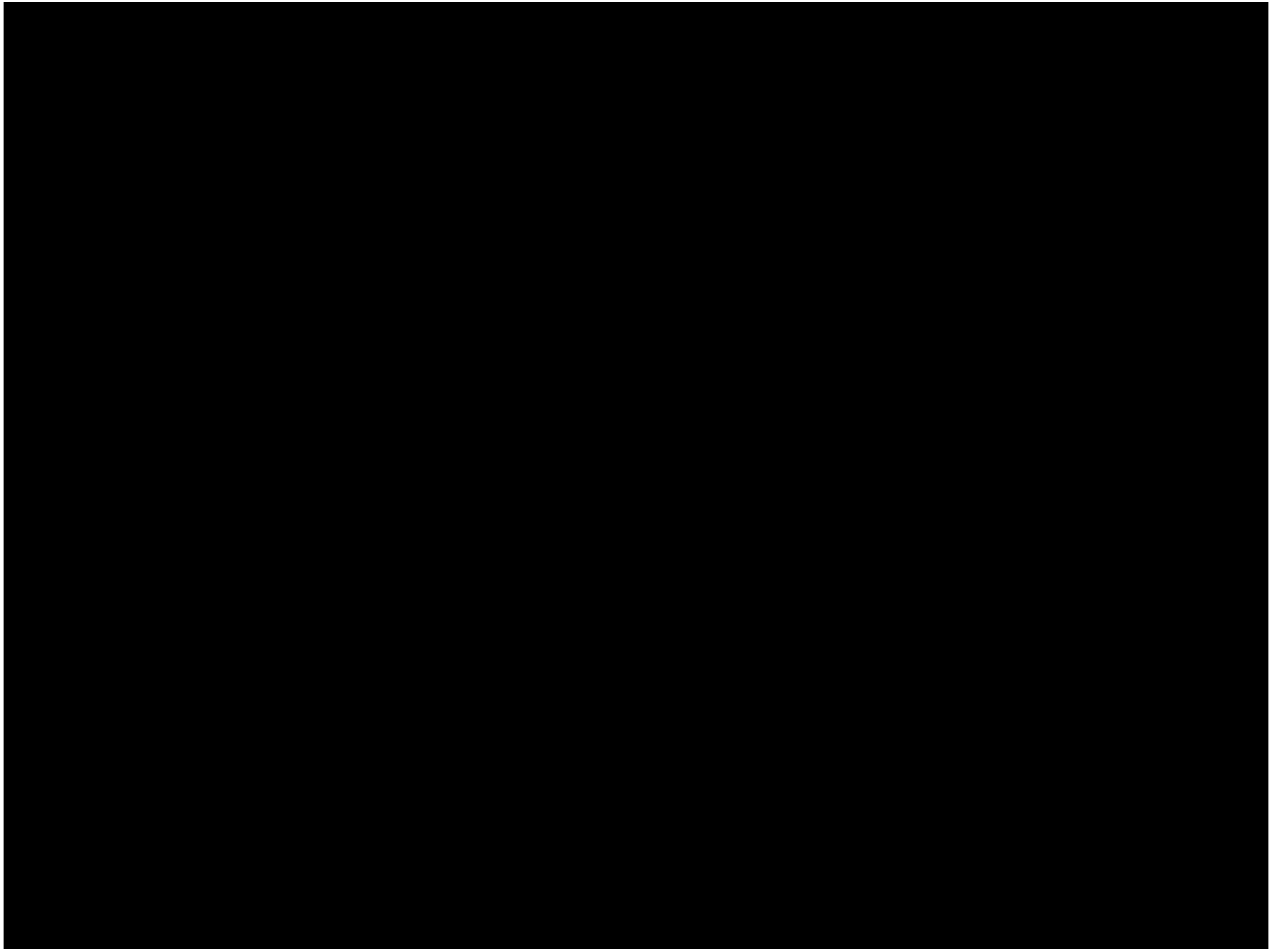
- Install [redacted] SGT in the southeast corner and [redacted] the northeast corner of the 275kV substation, with associated 400kV and 132kV equipment, bunds and cable connections.
- The southeast area has currently [redacted] spare transformers that have been marked for removal due to age. This area, like the southwest corner, is spacious enough to accommodate the SGT and equipment needed; however, design clearances (although met) are tight and leave no room for a demarcation fence.
- The area in the northeast of the 275kV compound contains a redundant/spare bay with only minimal aged equipment remaining on the concrete structures. This area would require clearing to leave room to construct the 400/132kV transformer and associated equipment independently of the 275kV decommissioning. The OHL route that is to be installed across the substation will also be clear of any interaction (as shown in the layout of this option).
- The northeast location has sufficient space for a separately fenced transformer compound and avoids the proposed overhead line route, while customer cable access is available from the south and southeast.



Option D-2D Installing [redacted] SGTs in the northwest DCO approved area of the existing 400kV substation

Proposed works:

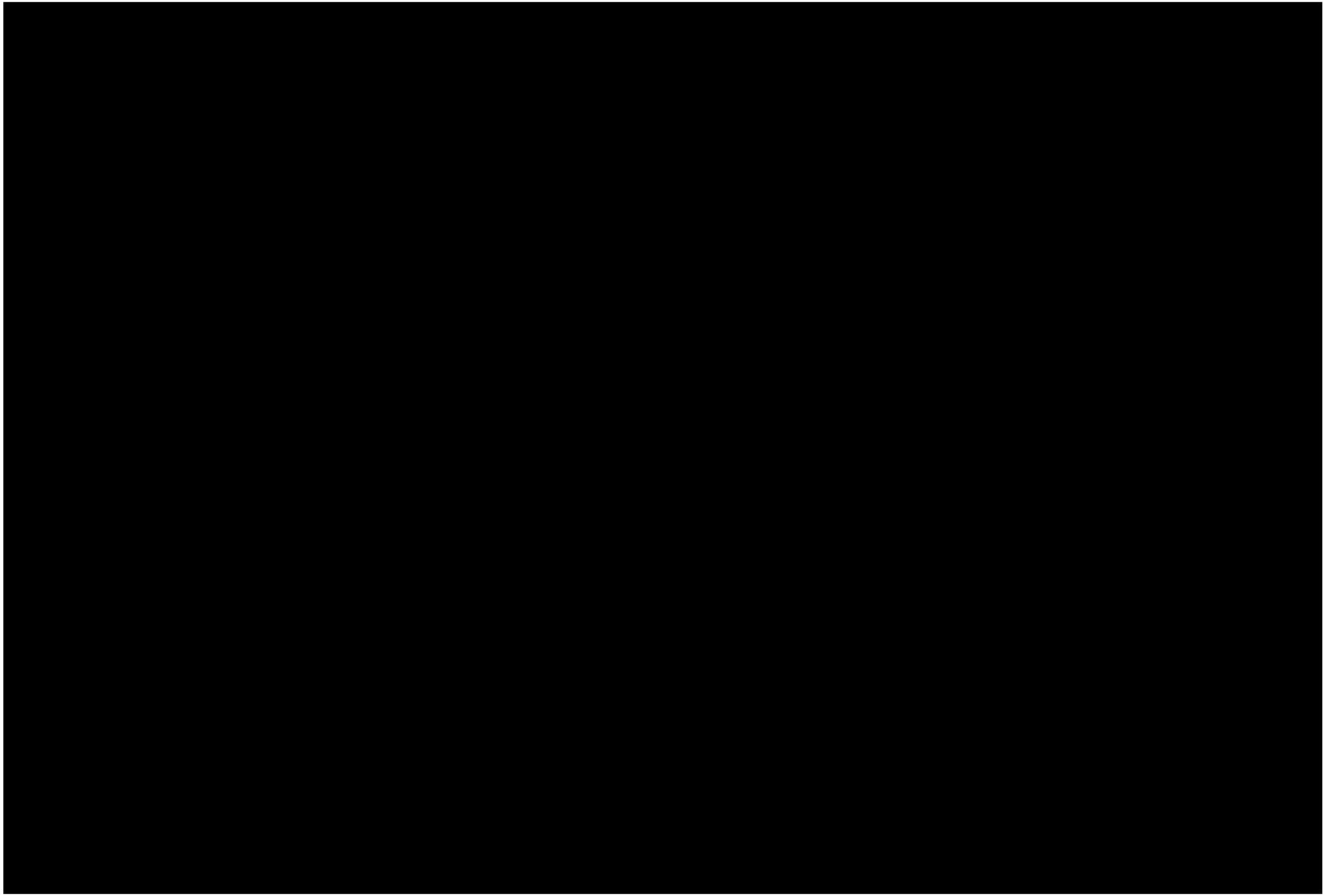
- Install [redacted] SGTs in the DCO-approved area northwest of the existing 400kV substation, with associated bays, bunds, a separately fenced compound and cable connections. This location provides comparatively short 400kV cable routes to the planned GIS substation.
- However, this option would require HWUP to change its design because the area is designated for contractor cabins and laydown until its works are complete. Changing the design at this stage is not feasible because HWUP are in the construction phase.



Option D-2E Installing [redacted] SGTs in the northeast and east parts of the 275kV substation

Proposed works:

- Option D-2E follows on the strategy of D-2D and utilises the area created once the existing 275kV substation is decommissioned.
- Makes use of the east half of the 275kV substation after the relevant equipment is decommissioned, with associated bunds, a separately fenced compound and cable connections.
- Customer cable access would be available from the east and south.
- However, delivery is dependent on the HWUP decommissioning sequence. [redacted] SGT construction cannot proceed until the remaining 275kV equipment is decommissioned and removed, creating uncertainty over whether sufficient offline construction time is available.



A summary of key differences among the five locations is below:

Table 10: Summary of key differences among shortlisted options

Option	Location	Key differentiating factor	Key challenge / dependency
D-2A	Southwest and southeast corners of the 275kV substation	• Direct southern customer cable exit. • Works remain within existing substation land.	• The northwest side (cables pass through this point in this option) is constrained to enable cable routing. It must cross numerous existing cables and services, increasing routing difficulty and construction risk. • Tight clearances leave no room for a segregation fence.
D-2B	Southeast and northwest corners of the 275kV substation	• Northwest area has space for a segregation fence.	• Northwest area is surrounded on three sides by retained 275kV (long-term access constraint). • The northwest side is constrained to enable cable routing. It must cross numerous existing cables and services, increasing routing difficulty and construction risk.
D-2C	Southeast and northeast corners of the 275kV substation	• The northeast area can be separately fenced and is clear of the proposed OHL route. • It avoids the longer southwest cable route and the retained 275kV access constraint in the northwest.	• Requires clearing of redundant bay equipment. • Temporary car park release and consenting interface (HWUP / [redacted]
D-2D	Northwest DCO-approved area of the existing 400kV substation	• Houses both SGTs in a single compound with short 400kV cable routes.	• Area retained by HWUP for contractor cabins/laydown until its works complete. Changing the design at this stage is not feasible because HWUP are in the construction phase.
D-2E	Northeast and east half of the 275kV substation	• Clear long-term layout, away from retained 275kV assets and the OHL route.	• Delivery is dependent on the 275kV decommissioning sequence – the second SGT cannot proceed until decommissioning is complete.

The System Design Table (SDT) for each shortlisted option is provided within Appendix B.

In appraising the five remaining options, we undertook a proportionate, multi factor qualitative assessment to determine which option delivers the best overall outcome for consumers, while meeting the investment drivers. The results are summarised in Table 11.

3.5 Qualitative assessment of shortlisted options

Table 11: Multifactorial analysis

Option	Optioneering categories: Engineering	Environmental	Deliverability	Economic / consumer value	Consenting / stakeholder
Option D-2A: Southwest and Southeast locations	**Southwest** × **Compound segregation:** No space for a separating fence, so the new and existing compounds cannot be permanently segregated. × **Maintenance access:** Access is constrained, making maintenance and equipment replacement more challenging. × **Outages:** Cable crossings likely to require multiple outages, increasing programme and operational coordination. × **Cable route exit:** Direct customer cable exit, but the cable route into the site runs through the congested northwest area, crossing existing cables and services, increasing routing difficulty and construction risk. **Southeast** ✓ **Compound segregation:** While construction would initially remain close to live equipment, the compound area can be separated once HWUP decommissions the 275kV substation (east), enabling a distinct long-term compound. ✓ **Site access:** The main access road adjoining the area would support construction and future maintenance.	**Southwest and Southeast** ✓ **Land footprint:** Works in both areas remain within the 275kV substation land, limiting additional footprint.	**Southwest and Southeast** ✓ **Construction dependency:** Construction is not dependent on completion of the wider 275kV decommissioning, reducing programme dependency and supporting earlier delivery.	**Southwest and Southeast** ✓ **Futureproofing and consumer value:** Makes use of existing planned HWUP infrastructure, avoiding a separate transmission investment and sterilisation of land that may support future development, reducing cost to consumers and preserving future optionality. **Southwest** × **Cable length:** The southwest area has the longest cable route, increasing cable quantity, installation and cost. **Southeast** × **Enabling works cost:** Spare transformers and bunds in the southeast area may require redesign / reconstruction, adding cost.	**Southwest and Southeast** ✓ **Land and consents:** Works remain within the 275kV substation land, limiting additional land and consenting requirements. **Southeast** × **Stakeholder coordination:** Cable-duct installation from the southeast area must be coordinated with HWUP haul-road use.
	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: Optioneering report
	Detractor	Neutral	Benefit	Detractor	Neutral

Option	Optioneering categories				
	Engineering	Environmental	Deliverability	Economic / consumer value	Consenting / stakeholder
Option D-2B: Southeast and Northwest locations	**Southeast** ✓ **Compound segregation:** While construction would initially remain close to live equipment, the compound area can be separated once HWUP decommissions the eastern side of the 275kV substation, enabling a distinct long-term compound. ✓ **Site access:** The main access road adjoining the southeast area supports construction and future maintenance. **Northwest** × **Constrained area:** Retained 275kV assets surround the area on three sides, constraining construction and future replacement. It also includes live equipment that presents safety risks. × **Operational access:** Development here would reduce access to the retained 275kV substation, creating a long-term constraint. × **Cable route:** The northwest is constrained to enable cable routing as the area crosses numerous existing cables and services, increasing routing difficulty and construction and safety risks. × **Outages:** Cable crossings from the northwest area require multiple outages, increasing operational coordination and programme risk.	**Southeast and Northwest** ✓ **Land footprint:** Works in both areas remain within the 275kV substation land, limiting additional footprint.	**Southeast and Northwest** ✓ **Construction dependency:** SGT construction in both areas does not rely on HWUP decommissioning, allowing earlier delivery. **Northwest** × **Deliverability:** The complex northwest cable route makes this a difficult location to deliver the connection to.	**Southeast and Northwest** ✓ **Futureproofing and consumer value:** Makes use of existing planned HWUP infrastructure, avoiding a separate transmission investment and sterilisation of land that may support future development, reducing cost to consumers and preserving future optionality. **Southeast** × **Enabling works cost:** Spare transformers and bunds in the southeast area may require redesign / reconstruction, adding cost.	**Southeast and Northwest** ✓ **Land and consents:** Works remain within the 275kV substation land, limiting additional land and consenting requirements. **Southeast** × **Stakeholder coordination:** Cable-duct installation from the southeast area must be coordinated with HWUP haul-road use.
	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: Optioneering report
	Detractor	Neutral	Neutral	Neutral	Neutral

Option	Optioneering categories				
	Engineering	**Environmental**	**Deliverability**	**Economic / consumer value**	**Consenting / stakeholder**
Option D-2C: Southeast and Northeast locations	**Southeast and Northeast** ✓ **Site access:** The main access road adjoining the southeast and northeast areas supports construction and future maintenance. **Southeast** ✓ **Compound segregation:** While construction would initially remain close to live equipment, the compound area can be separated once HWUP decommissions the eastern side of the 275kV substation, enabling a distinct long-term compound. ✓ **Site access:** The main access road adjoining the southeast area supports construction and future maintenance. **Northeast** ✓ The **northeast area** can be separated to ease construction, HWUP decommissioning of the existing 275kV substation and for future works.	**Southeast and Northeast** ✓ **Land footprint:** Works in both areas remain within the 275kV substation land, limiting additional footprint.	**Southeast and Northeast** ✓ **Construction dependency:** SGT construction in both areas does not rely on HWUP decommissioning, allowing earlier delivery. ✓ **Earliest delivery:** The combination of southeast and northeast locations supports the earliest possible delivery date for [redacted]	**Southeast and Northeast** × **Enabling works' cost:** Spare transformer bunds may require redesign / reconstruction and existing / disused spare bay in the southeast and northeast areas may be removed, adding cost and programme activity. ✓ **Futureproofing and consumer value:** Makes use of existing planned HWUP infrastructure, avoiding a separate transmission investment and sterilisation of land that may support future development, reducing cost to consumers and preserving future optionality.	**Southeast and Northeast** ✓ **Land and consents:** Works remain within finished substation land, limiting additional land and consent requirements. × **Stakeholder coordination:** Cable-duct installation must be coordinated with HWUP haul-road use.
	Supporting Evidence: FEED, Optioneering report	**Supporting Evidence: FEED, Optioneering report**	**Supporting Evidence: FEED, Optioneering report**	**Supporting Evidence: FEED, Optioneering report**	**Supporting Evidence: Optioneering report**
	Benefit	**Neutral**	**Strong Benefit**	**Neutral**	**Neutral**
Option D-2D: DCO-approved Northwest area	✓ **Layout:** The northwest DCO-approved area can accommodate [redacted] SGTs in one 400/132kV compound, simplifying the completed layout and shared access. ✓ **Compound segregation:** A full fence around the northwest DCO-approved area would improve operational segregation and future maintenance access.	✓ **Land footprint:** All equipment in the northwest DCO-approved area would remain within the future substation fence line and consented area, limiting any additional land footprint.	× **Construction dependency:** HWUP requires this area for contractor cabins and laydown until its build is complete, preventing the transformer works from starting when required, and delaying delivery by at least 3 years. × **Programme conflict:** As mentioned in Section 3.4, Shortlisted options, the cabins and laydown area cannot be relocated within the available land, leaving no	× **Enabling works' cost:** Development of this area requires [redacted] new transformer bunds and excavation for both cable routes, adding cost and construction activity. ✓ **Futureproofing and consumer value:** Makes use of existing planned HWUP infrastructure, avoiding a separate transmission investment and sterilisation of land that may support future development, reducing cost	✓ **Land and consents:** The works remain within finished substation land, limiting additional land and consenting requirements. × **Customer interface:** Circuit-end works for the northwest DCO-approved area require customer coordination, creating an additional delivery interface.

Option	Optioneering categories				
	Engineering	Environmental	Deliverability	Economic / consumer value	Consenting / stakeholder
			practical mitigation for the programme conflict affecting the northwest DCO-approved area.	to consumers and preserving future optionality.	
	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: Optioneering report
	Benefit	**Neutral**	**Strong Detractor**	**Neutral**	**Neutral**
Option D-2E: Northeast and east half of the 275kV substation	✓ **Site access:** The adjoining access point supports construction and future maintenance. ✓ **Layout:** The east half of the 275kV substation can accommodate [redacted] SGTs in one 400/132kV compound, providing a clear, consolidated long-term layout.	**Land footprint:** Works in both areas remain within the 275kV substation land, limiting additional footprint.	× **Construction dependency:** Existing equipment in the east half must be removed before the full option can be delivered. Moreover, construction in the east half is tied to the 275kV decommissioning creating a critical programme dependency and uncertainty over connection date. × **Construction sequencing:** Works in the east half must be staged around HWUP decommissioning, increasing complexity and delay risk.	✓ **Futureproofing and consumer value:** Makes use of existing planned HWUP infrastructure, avoiding a separate transmission investment and sterilisation of land that may support future development, reducing cost to consumers and preserving future optionality.	× **Stakeholder coordination:** Cable-duct installation from the east half must be coordinated with HWUP haul-road use.
	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: FEED, Optioneering report	Supporting Evidence: Optioneering report
	Strong Benefit	**Neutral**	**Strong Detractor**	**Neutral**	**Detractor**

Green Belt development – planning policy

The existing 275kV substation is located within the Green Belt. Regarding the proposed works within the existing substation operational compound, as NGET owns the substation site, NGET would not need to submit a planning application to carry out these specific works in the green belt as it has permitted development rights, subject to meeting certain conditions.

In relation to the area of land located outside the substation that may be used for site establishment and temporary car parking, [redacted] Planning Department has confirmed that the land on which these activities would take place is considered to be adjoining land for the purposes of Part 4 of Schedule 2 of the Town and Country Planning (General Permitted Development) (England) Order 2015. As these works will also be undertaken in accordance with National Grid's permitted development rights, there is no requirement to assess these works against Green Belt policy as well.

Qualitative assessment output

Based on the qualitative assessment, we prefer Option D-2C because it:

- Combines manageable land and consenting impacts with shorter cable routes and better construction segregation than the alternative options; and
- Avoids the more significant programme dependencies identified for Options D-2D and D-2E.

PASE alignment

The preferred option is classified as a PASE Variant Option, using the "Substation Extension: Extensions to SF_6-free GIS Double Bus Bar Substations" category as the closest applicable PASE solution. This investment's scope does not include construction of the new 400kV GIS substation, which HWUP will deliver separately. NGET's scope comprises the installation of [redacted] SGTs and the associated equipment required to connect them to the new substation.

The 400kV GIS Waltham Cross substation being delivered through the HWUP scheme includes [redacted]

Although this does not constitute a conventional extension of an existing substation, it represents an addition of assets and associated functionality to an SF_6-free GIS substation in addition to the baseline scope of HWUP. The PASE framework does not identify a separate category for standalone SGT installation. NGET therefore considers the substation-extension Variant Option to be the closest applicable PASE classification.

This approach is consistent with the underlying PASE principles by making efficient use of planned transmission infrastructure, avoiding the duplication of substation assets, minimising additional land requirements and providing an efficient means of connecting the contracted customer demand.

3.6 Quantitative analysis of shortlist options

Cost estimates of shortlist options

To assess the shortlisted options, cost estimates have been created for quantitative economic comparison. All capex costs are derived from NGET's latest Cost Book (23/24 prices). Estimating Units Lines (EULs) have been used to generate cost estimates based on the scope of work and the new assets to be acquired for each option. At each stage of project development, there are uncertainties associated with construction, commercial, stakeholder and supply chain activities, as well as external events, which may impact cost and schedule outcomes. Consistent with the level of project maturity at EL/ Needs Case (NC) stage, the current estimate includes the [redacted] risk and contingency allowance. This allowance has been informed by National Grid's experience of previously delivered projects and the risk events encountered during delivery, providing a proportionate representation of project uncertainty at this stage. Detailed Quantitative Schedule Risk Analysis (QSRA) and Quantitative Cost Risk Analysis (QCRA) assessments will be completed as part of Project Assessment to further quantify project-specific risks and update the allowance where appropriate

Table 12: Cost estimate breakdown

Options	OHL (£m)	Cables (£m)	Substation (£m)	Total (exc. risk (£m))	Biodiversity [redacted]	Total (incl. [redacted] risk (£m))
Option D-2A: Southwest and Southeast corners of the 275kV substation	-	[redacted]				
Option D-2B: Southeast and Northwest corners of the 275kV substation	-					
Option D-2C: Southeast and Northeast corners of the 275kV substation	-					
Option D-2D: Northwest DCO approved area of the existing 400kV substation	-					
Option D-2E: Northeast and east half of the 275kV substation	-					

Option D-2C has the lowest cost because it avoids some of the higher civil, access and programme-related enabling costs associated with the alternative options. It avoids Option D-2A's high cut/fill and flood wall costs, Option D-2B's additional flood wall extension, and Option D-2E's HWUP phasing-driven mobilisation/demobilisation cost.

Cost Drivers

The project's cost estimates are based on current market conditions, with ongoing work to refine requirements:

Using the cost book, the main factors driving the costs for the shortlisted options are:

- installation of [redacted] SGTs;
- associated 400kV and 132kV bay equipment;
- civil works, including foundations and cut and fill;
- 400kV cables, cable containment and cable sealing ends; and
- Addressing site specific deliverability constraints, including land contamination challenges (removal of asbestos and contaminated ground), flood removal and reinstatement, and removal of existing bunds.

Cost Benefit Analysis (CBA)

Purpose and approach

Our CBA evaluates the economic efficiency and consumer value of the proposed transmission investments. This analysis aligns with Ofgem's Load Re-Opener Guidance and Submission Requirements.

The CBA process integrates monetised benefits such as constraint cost savings, system efficiency improvements, and consumer bill impacts, alongside a comprehensive Whole-Life Cost Analysis (WLCA) that captures capital expenditure, replacement cycles, carbon impacts, and future extendibility. This dual approach ensures a balanced assessment of both short-term economic benefits and long-term cost efficiency, avoiding the risk of asset stranding or future inefficiencies.

Our CBA considers:

- Robust optioneering and sensitivity testing: We have evaluated credible alternatives, including 'do nothing' and 'do minimum' scenarios, to confirm that the preferred option delivers the optimal balance of technical performance, environmental impact, and economic benefit.
- Quantification of constraint cost reductions: Using system operator modelling outputs and historical data, we quantify expected savings from reduced system constraints, which translate into direct consumer bill benefits.
- Assessment of delay impacts: The financial consequences of potential project delays on constraint costs and consumer bills are modelled through risk-adjusted scenarios, providing a clear understanding of the value of timely delivery.

- Inclusion of socio-economic benefits: Where quantification is challenging, qualitative evidence supported by stakeholder engagement and regional development plans highlights the wider economic benefits, including job creation and inward investment.
- Consideration of non-monetised benefits: We explicitly identify benefits that are qualitative or not readily monetisable, such as enhanced system operability, resilience, and environmental improvements, ensuring full transparency of the value proposition.
- Alignment with policy and government targets including Net Zero and AI Growth Zones: The CBA reflects the influence of national and local policies, including Clean Power 2030, net zero commitments, and economic growth plans demonstrating how the investment supports the broader energy transition.

We have assessed consumer value by comparing the whole-life costs and benefits of five shortlisted connection and substation delivery options using Ofgem's RIIO-ET3 CBA template. The assessment is completed relative to a counterfactual and on a discounted basis over a 50-year appraisal period (2027–2076), consistent with the CBA methodology.

For each option considered, we have quantified:

- Initial Capital Expenditure (CAPEX) investment required
- Future end of life replacement cost

The supporting CBA model quantifies the costs and benefits for this project. Using the Ofgem RIIO-ET3 CBA template spreadsheet, the CBA compares the discounted cost and benefits for consumers for the following five shortlisted options.

- Option D-2A: Installing [redacted] SGTs within the southwest and southeast corner of the 275kV substation compound
- Option D-2B: Installing [redacted] SGTs within the southeast and northwest corner of the 275kV substation compound
- Option D-2C: Installing [redacted] SGTs within the southeast and northeast corners of the 275kV substation compound
- Option D-2D: Installing [redacted] SGTs in the northwest DCO approved area of the existing 400kV substation compound
- Option D-2E: Installing [redacted] SGTs in the northeast and east parts of the 275kV substation compound

CBA outcome

Lifetime Cost-Benefit Analysis: The lifetime costs and benefits refer to a 50-year period starting from 2027 until 2076

Table 13: Lifetime CBA (2023/24 prices, central carbon pricing, discounted values)

Option	Initial investment (£m)	PV of lifetime costs (£m)	PV of monetised benefits (£m)	NPV (£m)
Option D-2A: Southwest and Southeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2B: Southeast and Northwest corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2C: Southeast and Northeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2D: Northwest DCO approved area of the existing 400kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2E: Northeast and east half of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]

On the basis of the discounted lifetime CBA results (Table 13), Option D-2C delivers the highest NPV [redacted] 2023/24 base prices) and therefore represents the preferred option on consumer value grounds. This recommendation analysis is subject to confirmation through deliverability, consents/land, outage and risk considerations, and any CBA sensitivities (e.g. carbon price trajectories) set out in the assumptions below.

Assumptions of the CBA analysis

The CBA results are based on the following high-level assumptions (with sensitivities used to test robustness where appropriate):

- Appraisal period of 50 years (2027–2076), with costs and benefits discounted and presented relative to the counterfactual.

- Cost price: 2023/24 prices, aligned to the Ofgem RIIO-ET3 CBA template inputs (including treatment of replacement CAPEX and maintenance).
- Carbon: central base case carbon price applied for monetising construction carbon, SF6/alternative gas leakage and losses, with scenario testing for alternative carbon price trajectories.
- Benefits scope applied consistently across options; where option-specific benefits exist (e.g. constraints), the basis and evidence are documented and applied consistently.
- Key sensitivities considered (as applicable): timing/phasing, CAPEX uncertainty ranges, delivery/outage risk, and benefit parameter uncertainty (including losses and leakage assumptions).

Costs

Table 14: Summary of all additional Capex costs (2023/24 base prices)

Option	Initial works (£m)	Future replacement (40yr (£m))	Total costs (£m)
Option D-2A: Southwest and Southeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]
Option D-2B: Southeast and Northwest corners of the 275kV substation	[redacted]	[redacted]	[redacted]
Option D-2C: Southeast and Northeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]
Option D-2D: Northwest DCO approved area of the existing 400kV substation	[redacted]	[redacted]	[redacted]
Option D-2E: Northeast and east half of the 275kV substation	[redacted]	[redacted]	[redacted]

Benefits

The following benefits have been included within the CBA:

- SF6/Alternative gas leakage reduction
- Carbon cost of construction reduction
- Summary of all Benefits

Table 15 presents the summary of all (undiscounted) benefits, including environmental and non-environmental benefits, considering the central base case carbon price.

Table 15: Summary of all benefits

Option	Environmental benefits			Total benefits (£m)
	Carbon costs of construction (£m)	Gas leakage (£m)	Transmission loss (£m)	
Option D-2A: Southwest and Southeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2B: Southeast and Northwest corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2C: Southeast and Northeast corners of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2D: Northwest DCO approved area of the existing 400kV substation	[redacted]	[redacted]	[redacted]	[redacted]
Option D-2E: Northeast and east half of the 275kV substation	[redacted]	[redacted]	[redacted]	[redacted]

Preferred solution

The preferred option is Option D-2C, which installs [redacted] SGTs in the southeast and northeast corners of the existing 275kV substation. Option D-2C has the highest

NPV and the lowest initial cost of the shortlisted options and, when balanced against our multifactorial analysis, Option D-2C is preferred because:

- **Consumer value / economic performance:** it delivers the lowest cost and the highest NPV of the shortlisted options, supports the earliest connection date, ensuring timely delivery of the customer's contracted requirement.
- **Engineering:** the northeast area can be cleared and constructed independently of the 275kV decommissioning programme, and the location avoids the proposed HWUP overhead line route and retaining wall crossing, reducing construction complexity.
- **Environment:** works remain within the existing operational substation site, minimising additional land-take and environmental impact.
- **Planning, consent and stakeholder acceptance:** it is delivered within the existing operational boundary of the substation, limiting additional planning and consenting requirements.
- **Deliverability:** it avoids the HWUP-laydown dependency of Option D-2D and the decommissioning-sequence dependency of Option D-2E, reducing programme risk and supporting delivery to the agreed ACL.

3.7 Preferred Overall Solution

Following the optioneering set out in Section 3, Optioneering, our overall preferred option for the Project Red investment is Option D-2C, which installs [redacted] SGTs within the southeast and northeast corners of the existing Waltham Cross 275kV substation, connecting into two bay positions within the new 400kV SF_6-free GIS substation being delivered through HWUP.

Taken together, the preferred option enables the contracted [redacted] data centre connection while making efficient use of infrastructure already being delivered under HWUP, avoiding a separate standalone substation and minimising the cost to consumers. It aligns with the regional strategy to serve wider 132kV demand growth through [redacted] while progressing 400kV reinforcement at Waltham Cross. The total cost of the investment is [redacted] (23/24 prices). Of the total cost, Connection Charges directly funded by [redacted] are approximately [redacted] (excluding risk and contingency), while the rest ([redacted] are infrastructure costs.

The qualitative and quantitative analysis undertaken as part of the optioneering process demonstrates that the preferred option provides the most balanced and deliverable outcome when assessed against the criteria in the multi-factorial analysis.

Project benefits and outputs

The key outputs delivered by this option are as follows:

- Enables the [redacted] Data Centre demand connection at Waltham Cross.
- Delivers [redacted] SGTs.
- Makes efficient use of planned transmission infrastructure and avoids the need for a separate standalone substation solution.

- Remains within existing substation land, limiting additional land and consenting requirements.
- Supports construction and future maintenance through use of areas that can be segregated or accessed effectively as HWUP decommissioning progresses.

Futureproofing

The preferred option:

- is considered a least-regret solution because it satisfies the immediate contracted connection requirement whilst avoiding investment in infrastructure not currently supported by an identified customer need;
- aligns with the anticipated future direction of network development in the North London East / Hertfordshire area by making use of planned 400kV infrastructure at Waltham Cross while recognising [redacted] as the principal location for accommodating wider future 132kV demand growth. This approach represents a proportionate and coordinated use of network investment, avoiding unnecessary duplication of infrastructure and preserving flexibility for future network development; and
- preserves future optionality at Waltham Cross through use of planned HWUP infrastructure and avoids sterilising land that may support future transmission developments.

4. Delivery

4.1 Delivery year and indicative timeline

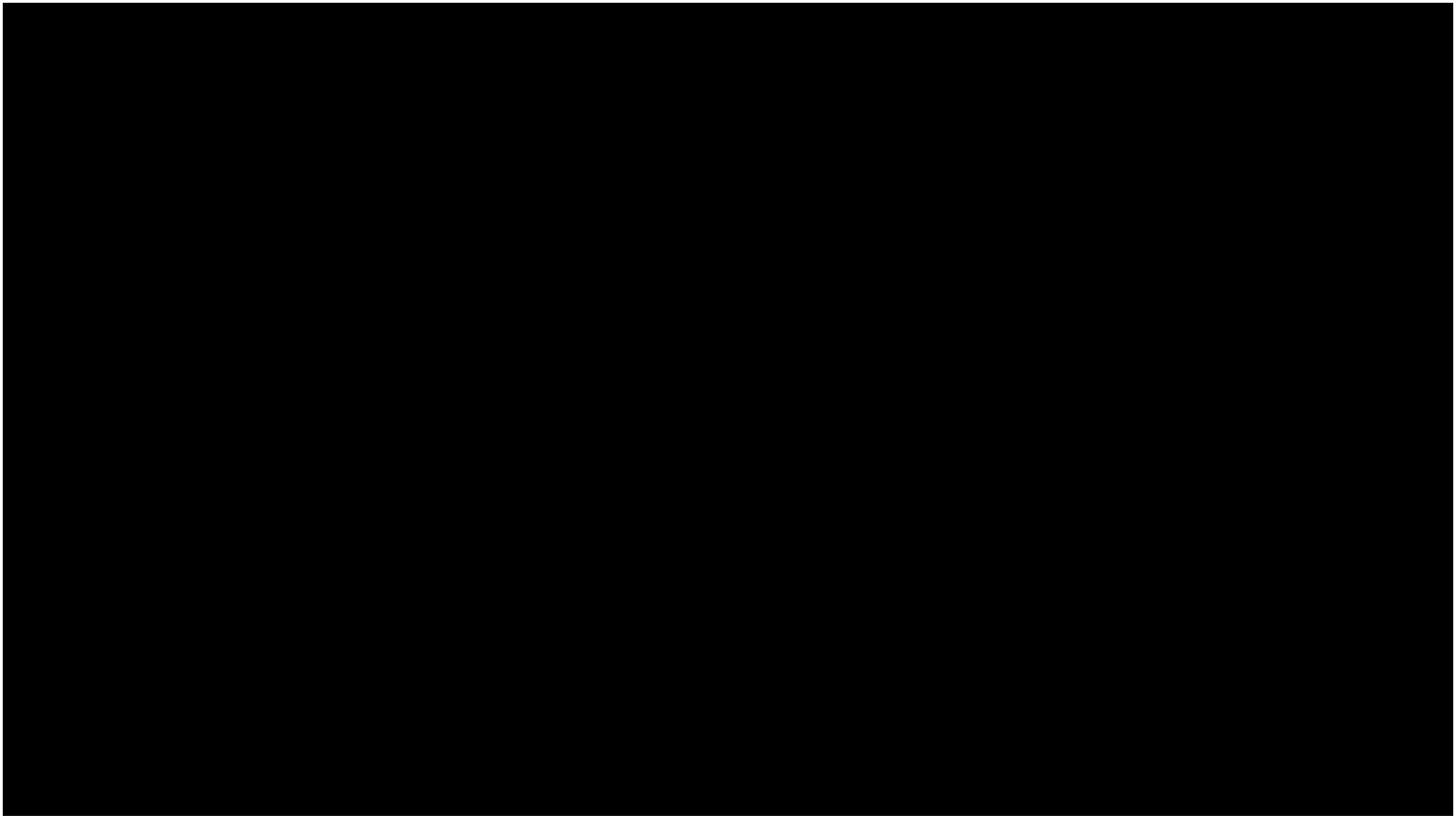
The delivery date for Project Red is [redacted]

However, the final energisation and commissioning date depends on the completion of the 400kV GIS substation at Waltham Cross (HWUP), and the availability of the relevant HV bay positions. We will update the latest delivery position during our Project Assessment submission.

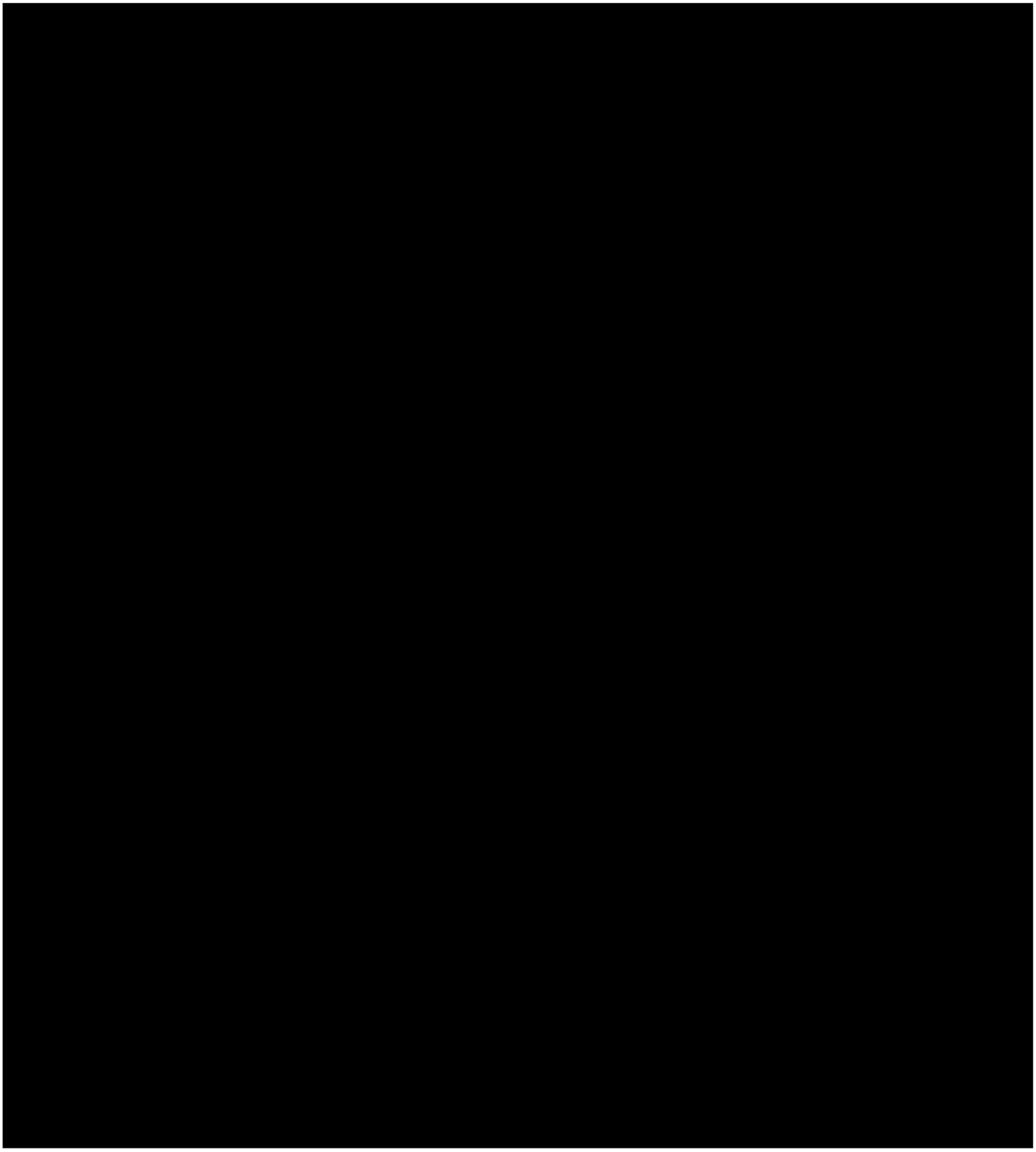
To manage these dependencies, we have been and will continue to coordinate closely with HWUP, the customer and relevant internal delivery teams. In addition, we are pursuing strategies to decouple as much of the project works as possible from the HWUP scheme. Our preferred option (using the northeast and southeast locations) would remove the dependency of the installation of SGTs on the HWUP decommissioning programme. This decoupling strategy significantly improves our ability to energise the two transformers by the revised ACL date of [redacted]

Figure 13 details the high-level program for Option D-2C. Key assumptions with this program are:

- SGT delivery dates assumed based on Q1 delivery time scales;
- Programme does not consider any blockers to the individual SGT locations (e.g. existing spare SGT removal);
- Successful provision of alternative car parking which leads to the release of the southeast and northeast locations by HWUP to Project Red by [redacted]
- Connection and commissioning dates depend on when the HV bay will be ready for energisation – to be agreed with HWUP scheme;
- Programme does not account for challenges with overlapping works. This is required to be discussed once more detail is understood;
- Demolition and work area preparation timescales are not included in this programme as not considered critical path and extent of demolition required to be decided between project red and HWUP schemes.



4.2 Procurement and contracting strategy



4.3 Risks and risk management

Table 16 sets out the six most material risks identified at this stage of project development. The risk register remains in development and will be updated as the project matures. Some risks may increase, reduce or no longer apply as design, delivery and procurement activities

progress. We will provide further detail in future regulatory submissions and can provide Ofgem with additional risk information if required before then.

Table 16: Summary of risks and mitigations

Risk	Mitigation
Interface with Other Works – Project Red is delivered alongside other works on site (HWUP). These concurrent activities create interfaces that require active coordination since Project Red's delivery is linked to the completion of the HWUP scheme.	Contact and procurement strategy required via the ETP framework to allow for a co-ordinated commissioning sequence. Regular meeting with procurement team to explore the opportunity to bundle the works with HWUP. The preferred option helps reduce this dependency because much of the work can be built offline and does not rely as heavily on the 275kV decommissioning programme.
Outages – There are various projects around London that require system access around the same time as Project Red. There is a risk that through prioritisation of some projects over others, any impact to the HWUP outages may impact Project Red as well.	Initial system design specifications and outage sequence works will be shared between the respective projects. HV system coordination discussions have initiated and will continue the design and planning stage. The Main Works contractor will liaise with NGET to plan and coordinate with the respective interacting project teams.
Underestimated Ground Contamination Conditions – There is a risk that unforeseen adverse ground conditions or contaminants, greater than included within the base estimate, may be encountered during civil excavation works.	Site investigation and potential Remediation - to be drawn down from risk if required
Brownfield construction within a live substation – This is a brownfield build in and around live 275kV and 400kV assets which can pose safety, access, cable routes and operational segregation challenges.	The preferred option helps to mitigate this risk although it will not be removed completely. The northeast area gives us a cleaner construction position. It can be better segregated from live assets and avoids many of the access and safety challenges linked to the alternative locations.
Temporary Carpark by HWUP - There is a risk that the northeast location for one SGT planned for HWUP's temporary carpark may not be released in time to Project Red for SGT installation as it has been marked by the HWUP scheme for temporary car park parking until 2030 or later.	We have identified the southwest corner of the 275kV substation for HWUP's use as car parking within the substation compound and we are engaging with the site operations team regarding this space. In addition, we are working collaboratively with the HWUP team to secure an alternative car park location for our collective use to facilitate the release of the northeast location. We have therefore approached Lee Valley Regional Park Authority, the owners of a field near the Waltham Cross substation, to lease the field for use on a temporary basis for the duration of the project who have agreed to our request.
Complexity of Cable Routing – Waltham Cross Substation is located within a highly constrained environment, bounded by woodlands and waterways that restrict site expansion and access. Consequently, routing the proposed 400kV cables and customer 132kV circuits into the site presents a significant delivery risk. Failure to secure a viable cable route could lead to programme delays, increased costs, and the need for additional planning consents or design modifications	We are undertaking early engagement with the customer to establish feasible cable routing options and interface requirements for their 132kV cables. Detailed surveys and route assessments within the 275kV substation will continue to inform the cable design, enabling safe crossings of existing cables/ services and reducing the risk of programme delays.

5. Conclusion

This submission seeks Ofgem's confirmation of eligibility under Special Condition 3.18, assignment to Track 2, agreement in principle to the preferred option (Option D-2C) based on the development and optioneering to date, and approval of Pre-Construction Funding under Special Condition 3.15.

The investment is required to deliver [redacted] contracted [redacted] demand connection at Waltham Cross. Option D-2C installs [redacted] SGTs into [redacted] bay positions within the new 400kV GIS substation being delivered under HWUP. The preferred option is the lowest-cost shortlisted option, with the highest NPV and the strongest balance of deliverability and consumer value. By using infrastructure already being built under HWUP, it avoids a separate standalone substation and minimises cost to consumers.

Further programme and cost details will be confirmed at Project Assessment. On this basis, we request Ofgem's confirmation of eligibility, Track 2 assignment, acceptance of Option D-2C and approval of the associated Pre-Construction Funding.

Appendix A
Glossary

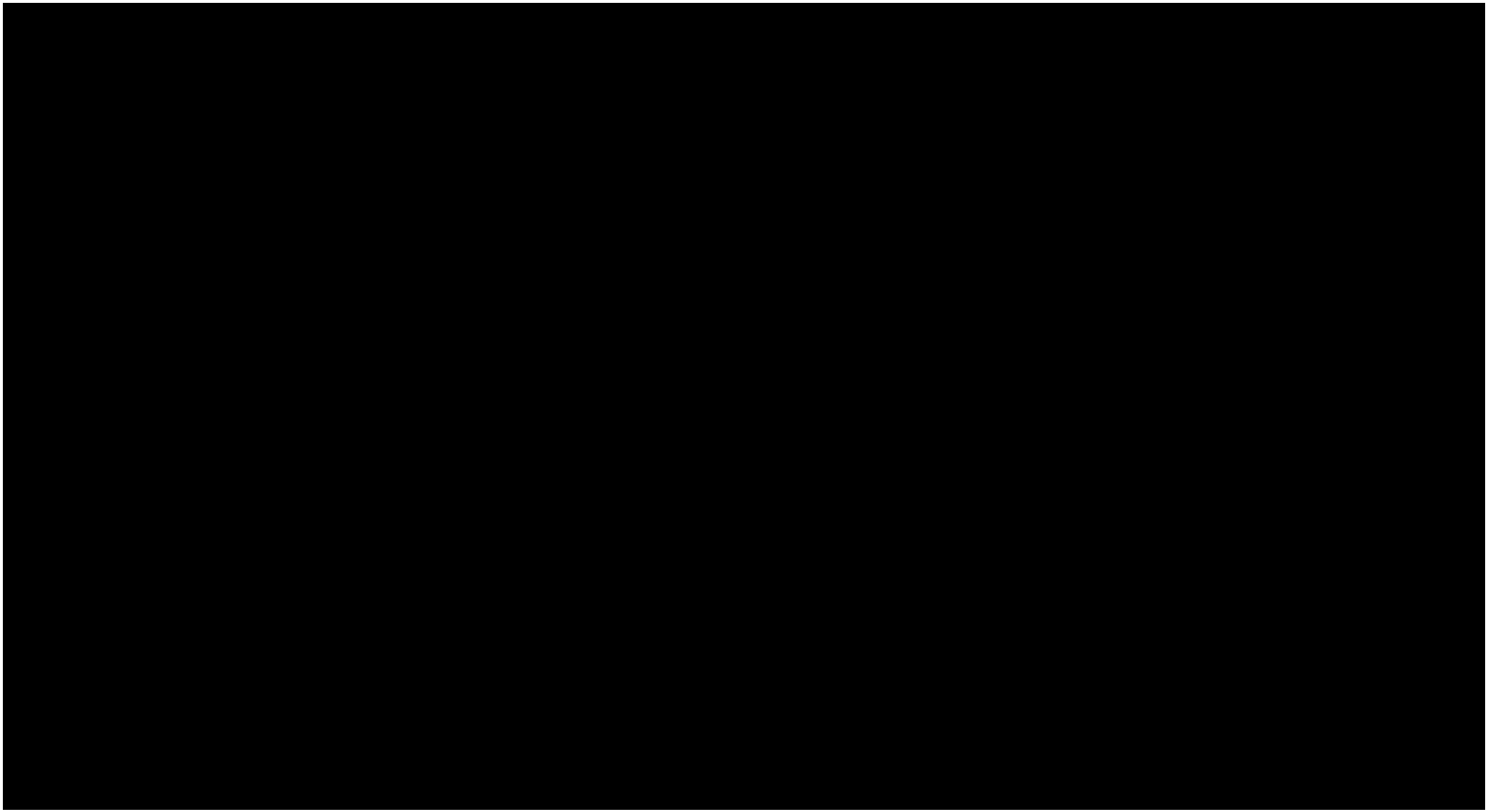
Table 17: Table of abbreviations and definitions

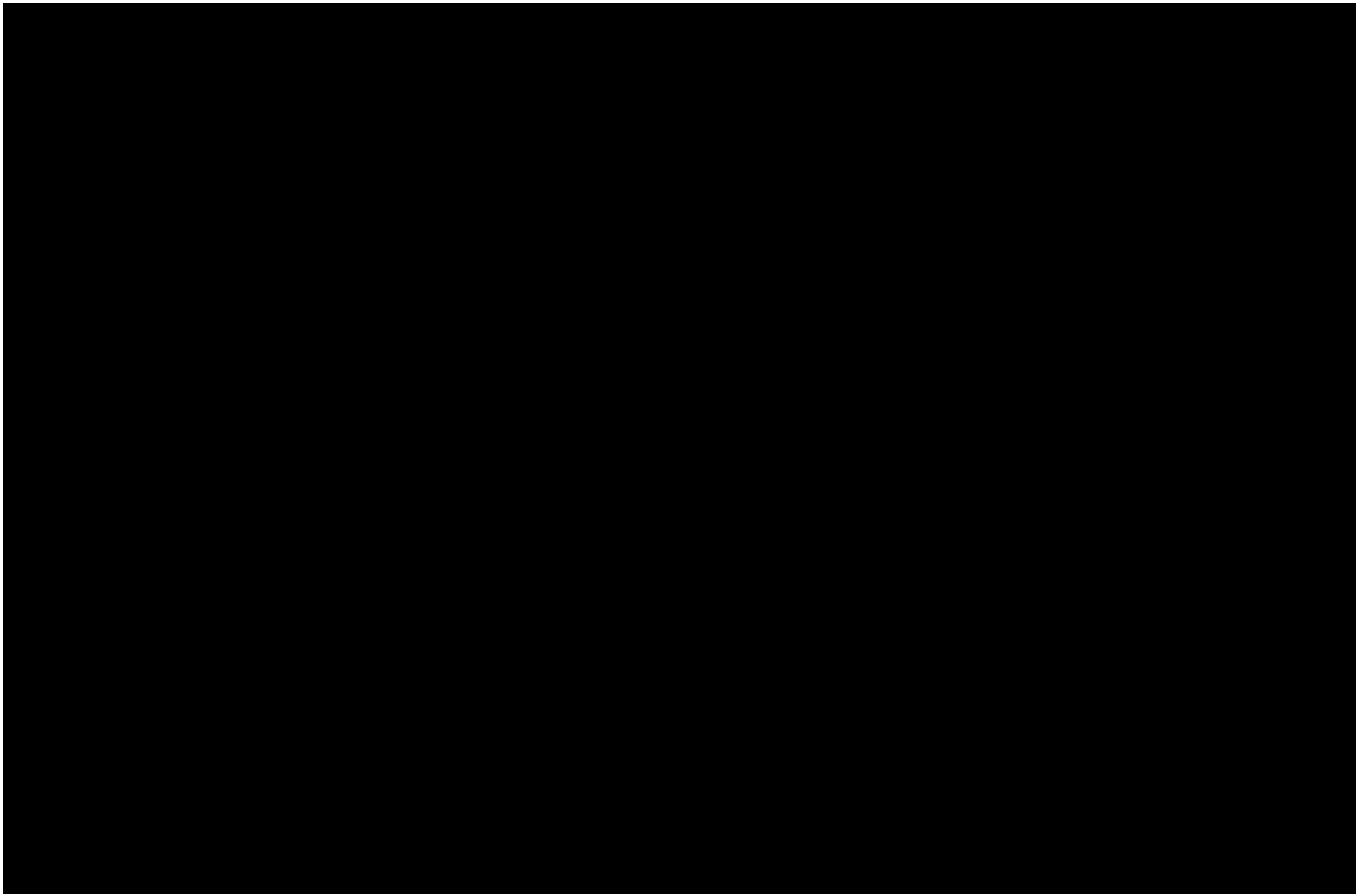
Abbreviation	Description
ACL	Available For Commercial Load
AIS	Air Insulated Switchgear
APM	Advanced Procurement Mechanism
BP	Business Plan
BPDT	Business Plan Data Template
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
CPO	Compulsory Purchase Order
CSE	Cable Sealing End
CT	Current Transformer
DCO	Development Consent Order
DNO	Distribution Network Operator
EAWO	Early Asset Write Offs
ECC	Estimated Cost of Construction
ECI	Early Contractor Involvement
EEW	Early Enabling Works
EJP	Engineering Justification Paper
EL	Eligibility Letter
EoL	End-Of-Life
ET	Electricity Transmission
ETP	Electricity Transmission Partnership
EUL	Estimating Units Lines
FEED	Front End Engineering Design
FID	Final Investment Decision
FY	Financial Year

Abbreviation	Description
GIB	Gas Insulated Busbar
GIS	Gas Insulated Switchgear
GW	Giga Watt
HWUP	Hackney-Waltham Cross Upgrade
HV	High Voltage
IEC	International Electrotechnical Commission
kW	Kilo Watt
LV	Low Voltage
LVAC	Low Voltage Ac
MVA	Megavolt-Amperes
MW	Mega Watt
NC	Needs Case
NESO	National Energy System Operator
NG	National Grid
NGED	National Grid Electricity Distribution
NGET	National Grid Electricity Transmission
NOA	Network Options Assessment
NPV	Net Present Value
OHL	Overhead Line
PA	Project Assessment
PASE	Pre-Approval of Solution Engineering
PCD	Price Control Deliverables
PCF	Pre Construction Funding
QCRA	Quantitative Cost Risk Analysis
QSRA	Quantitative Schedule Risk Analysis
RAV	Regulated Asset Value
RRP	Regulatory Reporting Pack
SDT	System Design Table
SF6	Sulfur Hexafluoride
SGT	Super Grid Transformer

Abbreviation	Description
SLD	Single Line Diagram
SuDS	Sustainable Drainage Solutions
TBC	To Be Confirmed
tCO2e	Tonnes of Carbon Dioxide Equivalent
TWNC	Tilbury-Waltham Cross reinforcement scheme
UKPN	UK Power Networks
VT	Voltage Transformer
WLCA	Whole-Life Cost Analysis

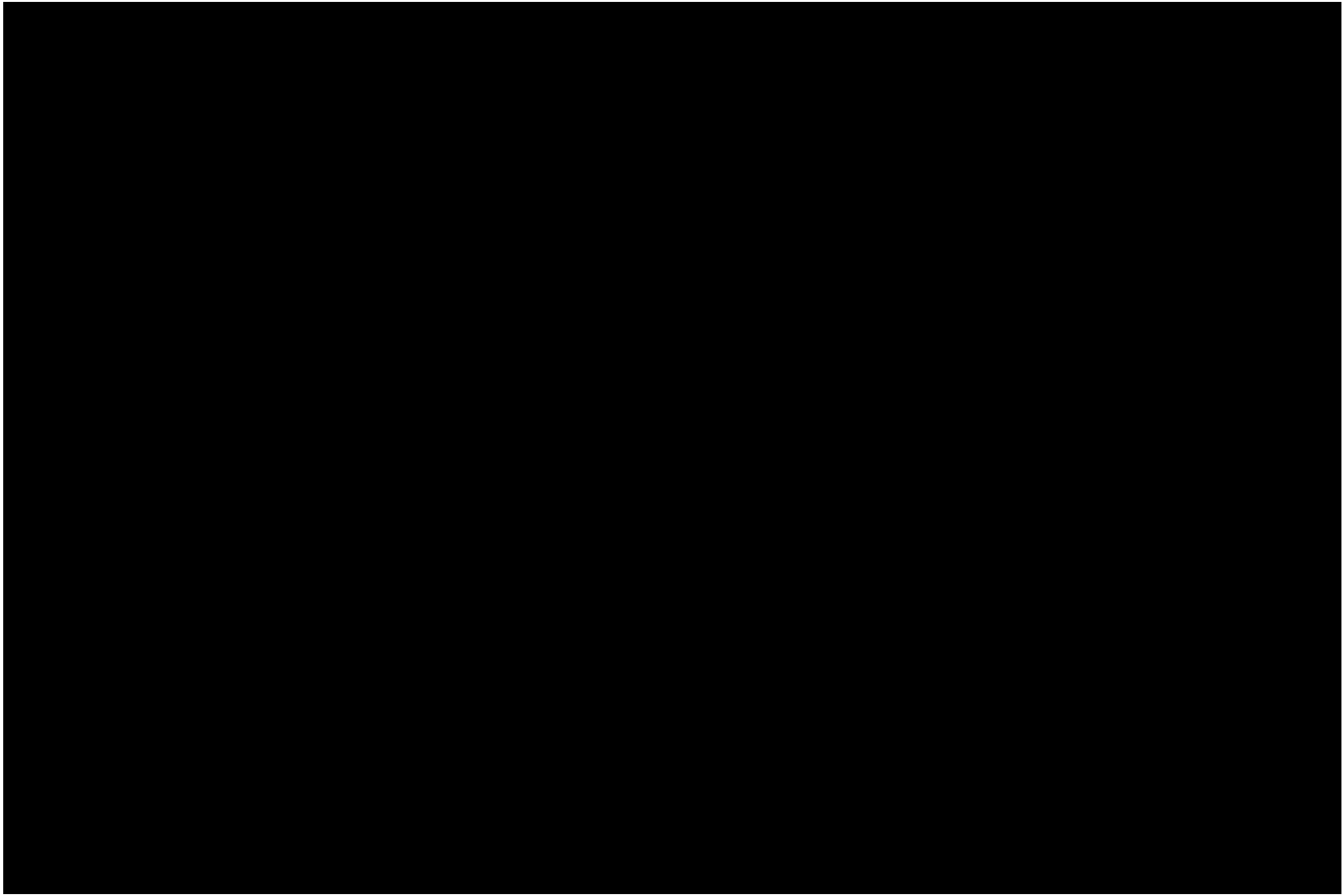
Appendix B
System Design Table





[5] While additional customer interest exists in the wider Waltham Cross area, these projects are not required to justify the proposed investment. The preferred option is fully justified by the contracted Google connection requirement alone. Future customer demand has therefore not been relied upon when selecting the preferred option and only provides contextual information regarding potential future utilisation of wider network infrastructure.

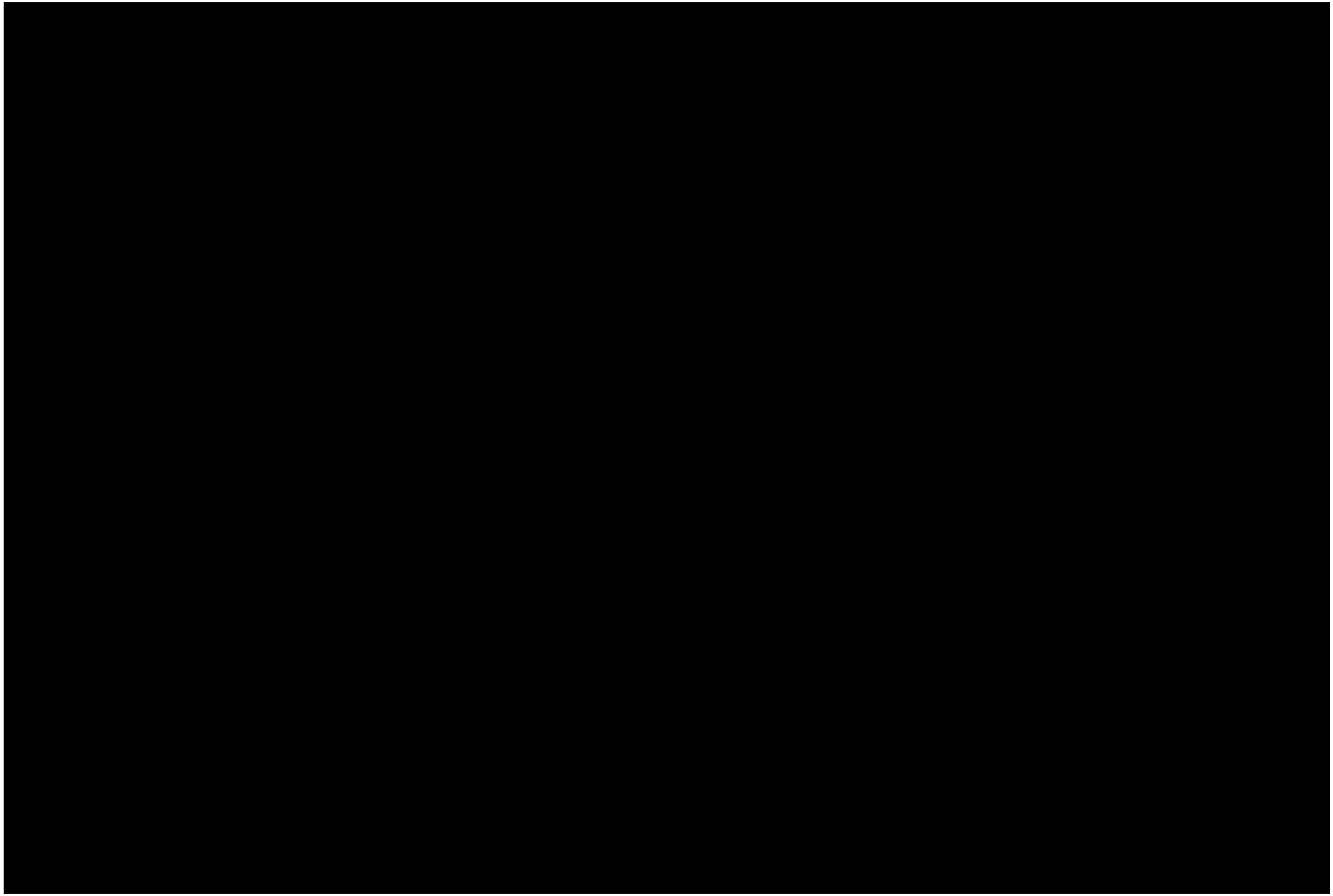






Appendix D
Layouts







National Grid plc
National Grid House,
Warwick Technology Park,
Gallows Hill, Warwick.
CV34 6DA United Kingdom

Registered in England and Wales
No. 4031152
nationalgrid.com