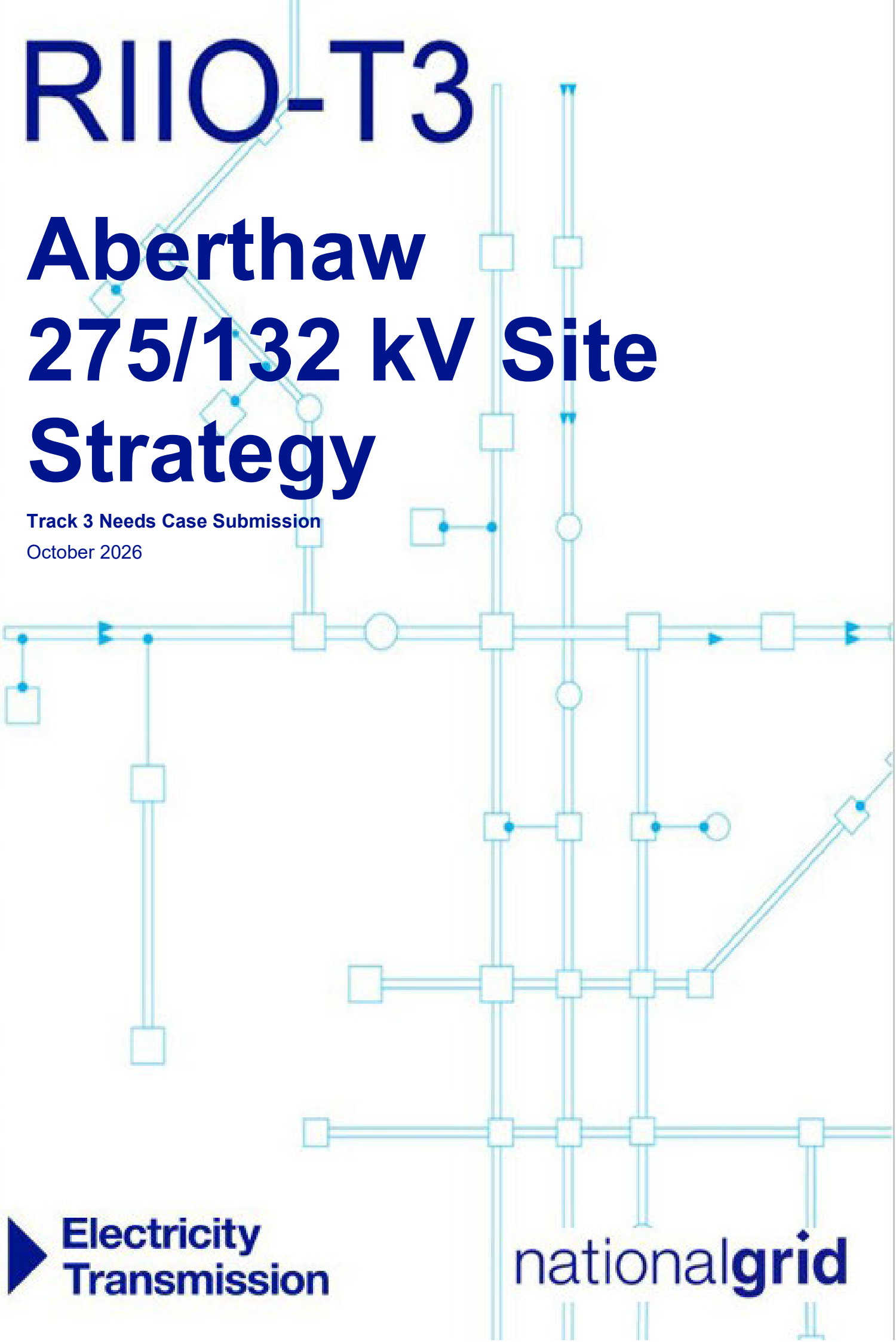
RIIO-T3

# Aberthaw 275/132 kV Site Strategy

**Track 3 Needs Case Submission**

October 2026



Electricity Transmission

nationalgrid

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# Reference and summary table

| Field | Description |
|---|---|
| **Project name** | Aberthaw 275/132 kV Site Strategy |
| **TO's preferred re-opener track** | Track 3 Needs Case (NC) |
| **RRP references** | [redacted] |
| **BPDT / Scheme reference number** | [redacted] |
| **Load board reference** | [redacted] |
| **Investment driver(s)** | The project consists of two primary investment drivers:<br>• [redacted]<br>• Asset health: existing Aberthaw 1950s and 1960s substations require significant outages and capital investment to address aged assets. |
| **Project outputs** | [redacted] |
| **Short list of strategic options considered** | The shortlisted options for Aberthaw 275/132 kV are:<br>• **Option D-1:** Do minimum works, utilising spare bays at existing AIS substation<br>• **Option E-2:** New substation build, non-SF6 GIS, cabled to existing OHL towers (assuming local site)<br>• **Option E-4:** New substation, non-SF6 GIS, OHL realignment to the rebuilt substation<br>• **Option E-6:** Prioritisation of 132 kV non-SF6 GIS rebuild, with a delayed 275 kV build |
| **Preferred solution and explanatory narrative on the rationale** | The preferred solution for this project is option E-4: a new GIS 275 / 132 kV substation.<br>This option accommodates all the drivers specified in the scope of works:<br>• Supports the timely delivery of customer connections, whilst minimising programme risk; and<br>• Asset health challenges associated with the existing substations. |

| Field | Description |
|---|---|
| | GIS has been selected due to the coastal location (~0.5km proximity to the coast) and the option's consenting and deliverability advantages, minimising land take and environmental/stakeholder impacts while enabling an offline rebuild that resolves legacy asset-health/operability constraints and provides robust futureproofing for contracted connections. |
| **PASE alignment** | The preferred solution for this investment is option E-4: a new GIS 275 / 132 kV substation.<br>The PASE guidance doesn't consider 275 kV infrastructure therefore this investment cannot be assessed for PASE compliance. However, should in future, PASE expand to cover 275 kV infrastructure then this investment would comply as a Variant option as an Indoor Double Busbar GIS in close proximity to the coast.<br>More detail on PASE compliance is provided in the PASE alignment section. |
| **Costs (23/24)** | Estimated capital cost: [redacted] |
| **Delivery year** | The delivery milestones for this project are:<br>• October 2031: Initial energisation [redacted])<br>• October 2032: Secondary energisation ([redacted])<br>• October 2033: Final energisation, completion of circuit transfers and DNO transfer<br>Dates are subject to procurement, contractor programme and confirmation of DNO programme. |
| **Applicable reporting tables** | BPDT 10.5 ET Pipeline log and RRP 2024-25 E1.11_ET Pipeline Log |
| **Interactive projects** | [redacted]<br>System access is currently planned considering all interactive outages and proactive project development choices to reduce the interactivity have occurred. |
| **Historic funding interactions** | [redacted] Historical funding section.<br>[redacted] |
| **Spend apportionment** | **T2 (FY 2022- 2026)** [redacted] **T3** [redacted] **T4+** [redacted] |

# Executive Summary

## Project Summary

Aberthaw is a RIIO-ET3 load-driven reinforcement and asset replacement project that will enable the timely connection of low-carbon generation, storage, and demand customers in the South-Wales region, while increasing capacity and operability at a strategically important transmission node.

It will support decarbonisation and wider net zero objectives, and support CP2030 by enabling large-scale BESS connections. The investment also preserves future extendibility at the site through spare capacity and safeguarded layout provisions.

## Submission Purpose

This Needs Case and associated Cost Benefit Analysis (CBA) are submitted as part of the RIIO-ET3 Load Reopener (LR) mechanism under Special Condition 3.18 (Load Re-opener and Price Control Deliverable) of the Electricity Transmission Licence Conditions. This submission seeks approval of the needs case, optioneering assessment and our preferred solution to deliver the Aberthaw 275/132 kV Site Strategy.

The project's eligibility for the Load Re-opener and associated Pre-Construction Funding was addressed through the Eligibility Letter process and is not a determination sought through this Needs Case submission.

## Need

[redacted]

At a high level this investment is progressing against three strategic contexts which are each carrying different levels of uncertainty. These are set out below.

- **Delivering for our customers:** [redacted]
- **Developing the network during reform:** Connections Reform is, however, introducing uncertainty in the wider future customer landscape at Aberthaw, particularly as generation and storage projects progress through the revised gate criteria. Section 2.1 of this investment paper sets out the current best-view of the customer position and how Connections Reform has introduced a new option to consider as part of a look back and check on our optioneering assessment.

- **South Wales regional strategy:** Current regional studies and the prevailing strategic context do not identify a present driver to uprate Aberthaw to 400 kV. The required outcomes can be delivered by reinforcing and renewing the 275/132 kV site while preserving optionality to accommodate future network evolution if required. Appended to this submission is a copy of the South Wales Regional Strategy which sets out more detail on the regional studies undertaken to satisfy ourselves that there is no current driver to uprate the network. We cannot not say, however, that there will not be a future need to add additional capacity to the network in South Wales (between 2035 – 2050) and therefore a key focus of the strategy has been to explore what future optionality exists should a driver emerge post 2035 with these investments delivered.

The asset health of the site supports a rebuild at Aberthaw. Site information confirms that the age and condition of both the 132 kV and 275 kV indoor AIS (1957 and 1965) would require increasing levels of intervention to maintain future safe and reliable operation. The emergence of the customer drivers has changed our approach from planning standalone, piecemeal replacements to managing the site on an interim risk-based basis that protects safety and operability while avoiding inefficient spend that would be stranded by the rebuild. In practice, we have prioritised monitoring and targeted mitigations for the highest-risk assets (and planned enabling/outage strategies accordingly), while coordinating the rebuild programme and asset health data to address the underlying end-of-life constraints in a single coordinated intervention alongside the load-driven scope.

In summary, while there is uncertainty in the wider future customer landscape as Connections Reform is implemented, the need to invest at Aberthaw is clear and time critical. Contracted strategic demand customers have defined requirements and delivery dates that must be met, and the existing asset base is ageing and increasingly risk-exposed; progressing the rebuild now is therefore the least-regret approach to maintain safety and operability, meet our contractual and licence obligations, and provide a robust platform for future network evolution.

## Optioneering to date

We undertook a structured, multi-factor optioneering process to identify a proportionate and deliverable consumer-solution in the interests of consumers. We first considered a range of strategic options, being do-nothing, market-based, whole-system, reuse existing or extension of existing assets, and new-build. From these, we build a longlist of eleven options, from which we shortlisted four for detailed analysis. These detailed options focused either on do-minimum works through utilising spare bays at the existing substation, or new-build.

Of these, option E-4 is our preferred solution because it balances deliverability, futureproofing, consumer value and asset health needs, while avoiding the limitations and risks associated with refurbishing the existing site, extensive cabling or a more complex staged rebuild.

Table 1: Summary of optioneering longlist

| Option | Details | Drivers met? | New site? | AIS/ GIS? | Shortlist? |
|---|---|---|---|---|---|
| **Option A** | Do nothing | No | No | NA | No |
| **Option B** | Market-based solution | No | No | NA | No |
| **Option C** | Non-transmission, whole systems solutions (DNO) | No | No | NA | No |
| **Option D-1** | Utilise existing AIS substation with 'do minimum' approach | Yes | No | AIS | Yes |
| **Option D-2** | Utilise existing AIS substation, whilst providing a GIS or AIS extension for additional bays | No | No | AIS/GIS | No |
| **Option E-1** | New substation build, AIS, cabled to existing OHL towers | Yes | Yes | AIS | No |
| **Option E-2** | New substation build, GIS, cabled to existing OHL towers | Yes | Yes | GIS | Yes |
| **Option E-3** | New substation, AIS, OHL realignment to the rebuilt substation | Yes | Yes | AIS | No |
| **Option E-4** | New substation, GIS, OHL realignment to the rebuilt substation | Yes | Yes | GIS | Yes |
| **Option E-5** | New GIS substation – minimal land take. Phased build to allow for the demolition of old 275 kV and rebuild 132 kV in place | Yes | Yes | AIS | No |
| **Option E-6** | New GIS substation – minimum land take. Phased build to allow for demolition of old 132 kV first | Yes | Yes | GIS | Yes* |
| **Option E-7** | New substation, transmission voltage built at 400 kV, interbus transformers provided locally. | No | Yes | GIS | No |
| **Option E-8** | New substation, transmission voltage built at 275 kV, 400 kV interbus transformers provided locally or remotely. | Yes | Yes | GIS | No |

**Option E-6 progressed to the shortlist post-connections reform because the loss of two 275 kV generation drivers has decreased the gains seen from cost of carbon from displaced generation, shifting the focus toward strategic demand and 132 kV delivery, making a phased solution that prioritises the 132 kV GIS rebuild more credible, lower risk upfront and better aligned with the revised project drivers.*

## Cost Estimates

Based on the latest Cost Book (which we have then rebased into 2023/24 prices) and early project estimates, the preferred option, option E-4, has an estimated total cost of [redacted] including risk and contingency.

The cost (23/34) for other shortlisted options (including risk and contingency) are:

- Option D-1: [redacted]
- Option E-2: [redacted]
- Option E-6: [redacted]

## Indicative Delivery Programme

[redacted]

# 1. Introduction

## 1.1 Aberthaw 275/132 kV Site Strategy

This paper presents our Track 3 Needs Case under the Load Re-opener and Price Control Deliverable under Special Condition 3.18 for investment to rebuild 275/132 kV Aberthaw substation. Through this submission, we are seeking:

- Approval of the investment need, optioneering and our preferred option (E-4), which is to build a new GIS 275/132 kV substation, connecting via overhead lines;

The investment is driven by contracted connection requirements at Aberthaw, including PV, BES [redacted] The investment is also driven by asset health considerations, due to the aging original infrastructure of existing site.

Subject to Ofgem approval of the needs case and our preferred option, we will continue development and intend to submit a Project Assessment in line with the Load Re-Opener process.

### Track & PASE

Aberthaw is driven by contracted customer connections, which cannot be accommodated at the 275/132 kV existing substation due to the aging original infrastructure which is approaching end of life. Continued investment in new connection assets within the existing 132 kV and 275 kV substations would lock consumers into substations with inherent reliability, safety, outage and maintainability risks over the notional life of the new plant, unless used only as a temporary transition to replacement substations. The investment is load-driven and triggered by contracted customer requirements and completion dates.

Our original proposed Track 2 allocation had been discussed with Ofgem. However, in Draft Determination's for the investments submitted within the May 2026 Load Re-Opener window, Ofgem decided this project should fall within Track 3.

The PASE guidance does not include 275 kV infrastructure as a PASE aligned option, however, should in the future PASE expand to cover 275 kV infrastructure then this investment would comply as a as a variant option as an Indoor Double Busbar GIS near the coast.

## 1.2 Background

### Chronology

The Aberthaw site has high customer interest which has triggered the need for a site strategy. [redacted]

rebuilt site. The project passed Gate B1 in September 2025 with early contractor input indicating a first ACL of [redacted]

Figure 1 provides the summary of chronology to the investment, while Table 4 provides a breakdown of the contracted customers' detail.

[redacted]

## Regional & Network context

### Regional South Wales strategy

South Wales is expected to play a growing role in delivering UK clean power ambitions and significant economic growth. National Grid Electricity Transmission (NGET) is progressing a programme of transmission investment [redacted] to maintain reliability, increase transfer capability, and enable substantial growth in both generation and demand. Post Connections Reform indications suggest a South Wales pipeline of approximately [redacted]

Near term delivery is driven by this Aberthaw and Margam substation rebuilds on the 275 kV network, alongside targeted transformer and circuit uprates (e.g., Whitson, Iron

[1] Gate B refers to an internal governance checkpoint where projects must meet a set of criteria to pass from Early Development to Detailed Development (planning, sanction and supply chain).

Acton/Melksham) and the Severn Cable Tunnel upgrade. These schemes are driven strategically significant industrial and economic development projects (e.g., the Tata Steel Margam/Port Talbot connection, and data centre and development zone demand dependent on Aberthaw).

To address Ofgem's concern regarding the potential for short term customer driven investments conflicting with longer term strategic network strategies we have developed a refresh of our regional strategy which has been submitted alongside this investment paper.

This fresh look at the network strategy integrates evidence from (i) customer triggered connection studies (near term statutory offers), (ii) Strategic Network Planning (SNP) analysis aligned to 2035 planning backgrounds, and (iii) Net Zero Engineering (NZE) stress testing extending toward 2050.

This combined approach tests compliance, operability and resilience under a range of credible futures, while recognising that electrical feasibility alone does not determine the optimal pathway (cost, deliverability, consenting, outages and customer impacts are material).

Across these analyses, the consistent near and medium-term [redacted]

[redacted]

As a result, committing prematurely to a 400 kV solution would risk higher consumer cost, increased delivery/consenting complexity, and potential delay to strategic customer connections in the absence of a clear needs case.

### Reactive compensation requirements

[redacted]

Figure 2: Location of the Aberthaw site on NGET's network

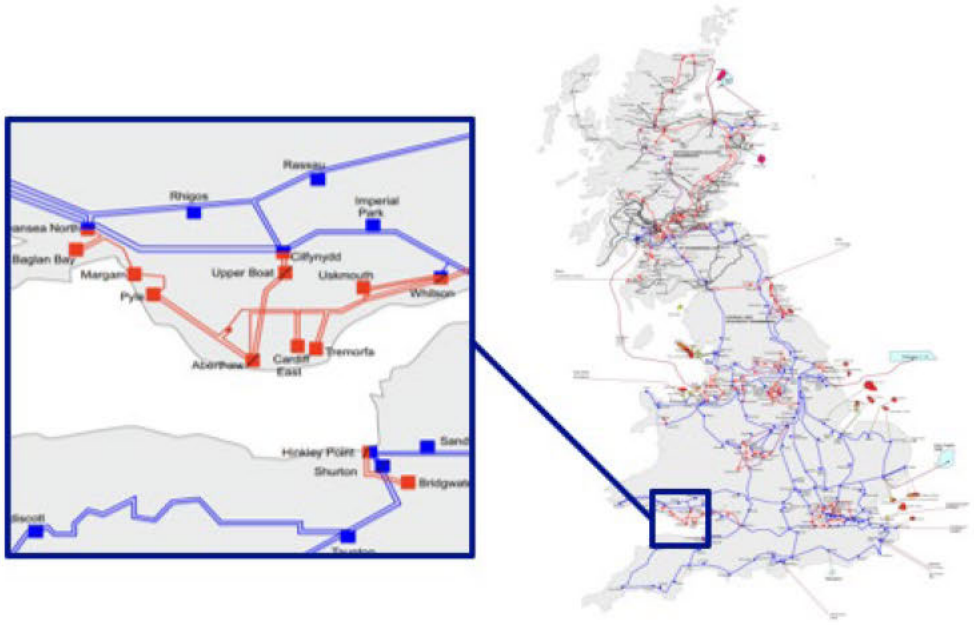
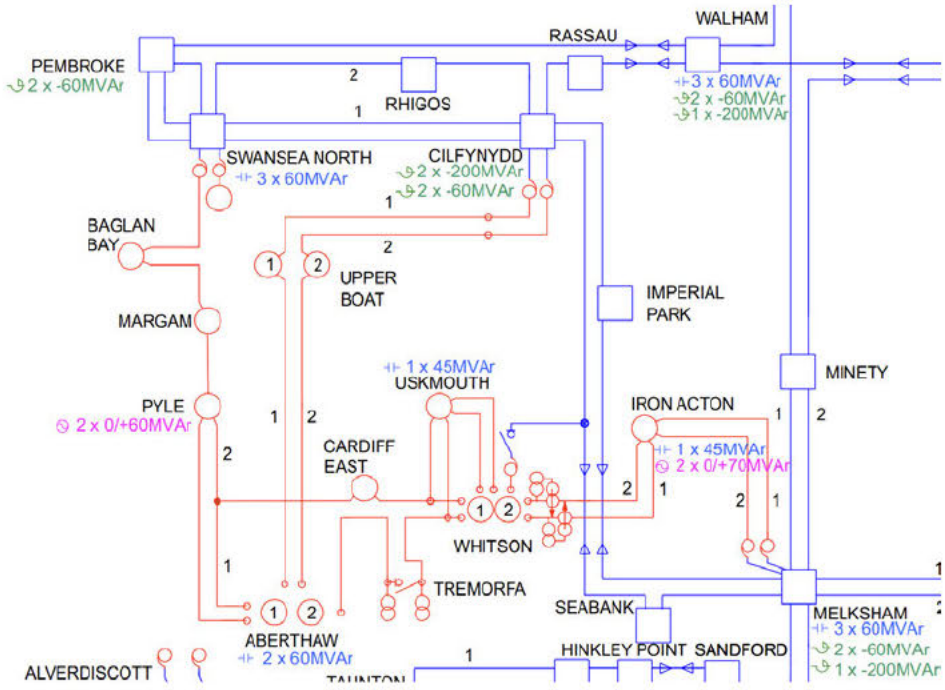



Figure 3 below provides a schematic illustration of the existing network in the South Wales region.

Figure 3: Network configuration around Aberthaw




**Interactive Projects**

[redacted] System access is currently planned considering all interactive outages and proactive project development choices to reduce the

interactivity have occurred. [redacted]

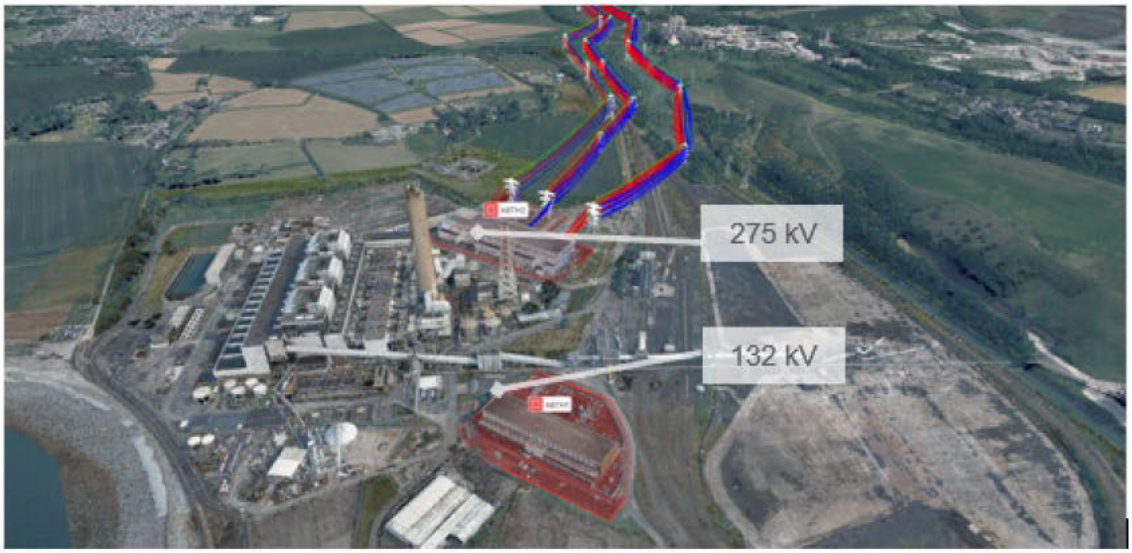
The Separation of Services scheme is currently completing separation works following the decommissioning of the former Aberthaw Power Station and disconnection of power station utilities. This work is expected to complete ahead of construction first site access but will result in an early asset write off cost as outlined in the Early asset write off section.

## Site background

The existing Aberthaw site is comprised of two indoor AIS sites, a 132 kV and 275 kV built in 1957 and 1965 respectively. The substations were designed to step up the generation voltage from the Central Electricity Generating Board (CEGB) Aberthaw Power Station which is sited between the two. Figure 4 below shows a satellite image of the Aberthaw site with the connecting OHL overlaid. The substations consist of:



Figure 4: Aberthaw Substations and Surrounding Setting, with OHL model Shown (April 2025 Survey)




[redacted]

[redacted]



## Historical funding

We've carried out interventions on various assets within Aberthaw 275/132 kV substation during RIIO-ET1 and RIIO-ET2 and recovered [redacted] (18/19) in allowances.

An overview of historic T1 and T2 asset health interventions for the Aberthaw 275 kV substation is presented in Appendix A.

There have been no allowances awarded to date for this investment.

## Early asset write off (EAWO)

The estimated remaining Regulated Asset Value (RAV[redacted]

# 2. Drivers and needs case

A significant customer driver for the Aberthaw investment [redacted] for more [redacted] capacity and uprating of all SGTs at Aberthaw.

However, there are a diverse range of other important investment drivers for Aberthaw – all of which are set out in Table 2 below.

[redacted]

[redacted]

## 2.1 Customer

Table 3 below provides our latest view of the customer ACL dates which reflect the existing P6 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 which is Project Assessment.

### Connection Assets

Due to the new build with numerous connections, it is not considered practical to have simultaneous working parties constructing GIS apparatus. This will decrease commissioning outage requirements and avoid any one customer delaying the completion of the GIS board, particularly where they form a mid-bay. The boundary is CUSC 2.12.1 (f) (i). In practice, the cable sealing end gas to cable bushing will form the boundary. This is to avoid connection operators owning a short section of gas insulated busbar. Busbar extension is included as an infrastructure element to capture the busbar element of a modular GIS bay. Given this is procured as one item, it is an attempt to capture some cost split at this early stage rather than procuring additional plant.

[redacted]







[redacted]

[redacted]

## 2.2 Asset health

There are asset health/non-load drivers for interventions at this substation alongside the predominant load-related drivers for investment. These asset health drivers are considered likely to affect the scope and timing of the preferred load-related intervention and have been a critical factor in evaluating suitable design solutions throughout FEED development. Most

[redacted]

Due to the planned scope of works covered by this submission, most of the assets that met the non-load intervention criteria were excluded from the non-load plan [redacted] his submission seeks funding only for the load-related scope described herein. Where load-related scope delivered through reopeners replaces previously allowed non-load-related (NLR) asset funding included within the T3 Final Determination, the corresponding NLR outputs will not be delivered and therefore the NLR PCDs will act as designed to remove associated NLR funding.

A summary of the current asset health position at Aberthaw is provided in Table 7 and Table 8. This reflects our most recent assured view of asset condition at the site and is included solely to support the needs assessment for the proposed load-related investment. There are some asset types for which detailed condition data is not yet included within our asset health database at an individual asset level and is therefore not reflected in the summary. These assets include post

[2] This was submitted as part of our response to the RIIO-T3 Draft Determination.

insulators and primary civils, which represent a significant asset health driver for this scheme of works.

[redacted]

[redacted]



Where there are higher-risk assets at the site, we will continue to assess and manage the risks until the project is delivered. We will provide details and cost information for the asset health interventions to be included in this project at Project Assessment stage.

# 3. Optioneering

We follow a structured, multi-factor optioneering process to select the most economic and efficient solution, in the interest of consumers. In line with the Electricity Transmission Design Principles, our optioneering process considers engineering, environmental, deliverability, economic and stakeholder factors. We start by assessing the most suitable strategic options.

## 3.1 Strategic options

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

Table 8: Strategic options summary table

| Option Number | Option Name | Option Description |
|---|---|---|
| A | Do nothing | The network is kept in its current state, and no new connections are facilitated. |
| B | Market based solution | Increased customer demand is accommodated through the procurement and use of ancillary services only. |
| C | Whole systems solution | The required customer connection is accommodated by a DNO. |
| D | Make use of existing assets | Facilitating the requested connection by utilising the existing substation (extension, uprating, etc.) |
| E | New build | Facilitating the requested connection by building a new substation. |

Options A, B, and C were eliminated early in our evaluation process due to licensing and contractual constraints, and these options also do not meet the customer drivers. As detailed below, our initial high-level assessment concluded that the drivers could be effectively met by building a new substation. A descriptive rationale is explained in Table 11.

## 3.2 Siting

### Scope of the siting study

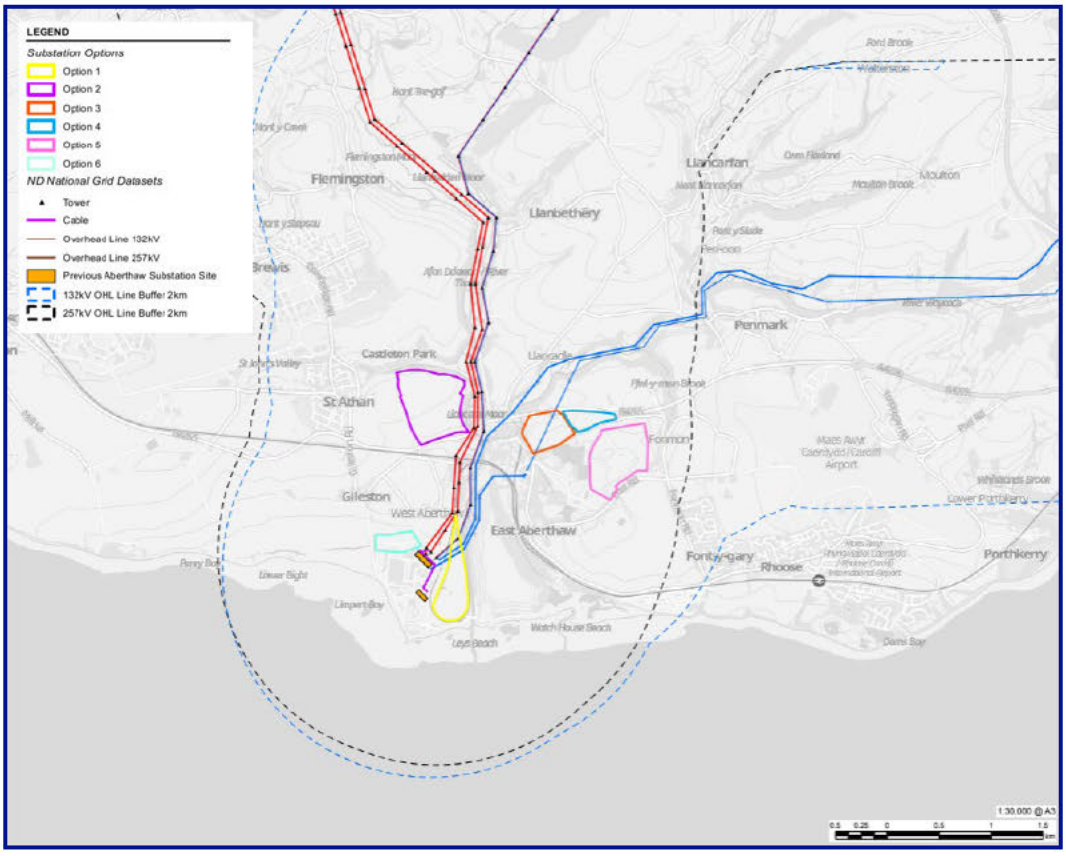
As option E would require a new site, a siting study was conducted to locate the most suitable location for the combined substation. Six candidate sites (capable of both AIS & GIS layouts) were assessed, and Site 6 was selected as the preferred site, after taking into consideration various consenting and programme risk constraints.

The study shortlisted six sites against environmental, planning, socio-economic and grid-connection criteria. The six options assessed for the Aberthaw Siting Study were:

- **Site 1:** Located in the southern extent of the Study Area, in the boundary of the former Aberthaw Power Station located immediately east of the existing OHL and east of the current 275/132 kV substations.
- **Site 2:** Located in the northwestern extent of the Study Area, located immediately west of the existing OHL, east of St Athan and north of the former Aberthaw Power Station.
- **Site 3:** Located in the eastern extent of the Study Area, located east of the existing OHL, immediately south of the B4265 and north of the mineral sites.
- **Site 4:** Located in the eastern extent of the Study Area, located adjacent to option 3. Option 4 is south of the B4265 and east and north of the mineral sites at Aberthaw.
- **Site 5:** Located in the southern extent of the Study area, located ~500 m east of the existing OHL.
- **Site 6:** Located in the southern extent of the Study Area, in the confines of the car park of former Aberthaw Power Station located immediately west of the existing OHL and northeast of the previous 275/132 kV substations.

Figure 8 below shows the boundaries of the six shortlisted sites.

Figure 8: High-level options for Aberthaw siting study[3]




[3] Full size images of the site options are included in Appendix C

As part of our Environmental study, "RAG" (Red, Amber, Green) analysis was conducted for these Site options, with a summary of the results shown in Table 9 below.

Table 9: Qualitative analysis table of remaining site options

| Site Option | | | | | | |
|---|---|---|---|---|---|---|
| **Environment** | | | | | | |
| Biodiversity | | | | | | |
| Landscape and Visual | | | | | | |
| Historic Environment | | | | | | |
| Geodiversity and Agricultural Land | | | | | | |
| Water Environment | | | | | | |
| Noise | | | | | | |
| **Socio Economic** | | | | | | |
| Socio-economic | | | | | | |
| **Technical (Safety)** | | | | | | |
| Technical (Safety) | | | | | | |
| **Technical (OHL)** | | | | | | |
| Technical (OHL) | | | | | | |
| **Technical (Constructability)** | | | | | | |
| Technical (Constructability) | | | | | | |
| **Cost** | | | | | | |
| Cost | | | | | | |
| **Consenting, Lands and Programme** | | | | | | |
| Consenting, Lands and Programme | | | | | | |

## Siting conclusion

Site 6 was chosen for its balance of advantages: it's on brownfield land next to existing substations, allows connection without major OHL diversion, and minimizes impact and risk. Its location reduces build costs, network disruption, ecological and heritage effects, and flood or contamination risks compared to other sites. It also supports future GIS expansion, though there remains some acquisition risk due to an RWE-held option.

An alternative site which could host the footprint of an AIS solution[4] is site 1, this would however introduce substantial extra impacts, including OHL diversions likely to require DCO processes, significantly greater engineered solutions (e.g. flood defences), greater ecological and heritage effects, and materially increased planning and programme risk. [redacted] In this context, GIS at Site 6 is the only option identified that can meet the network requirement in a proportionate, deliverable and future-proof manner without creating materially greater consenting, environmental and programme risks.

[4] The review identified an AIS solution would require a footprint up to ~25 ha with operational allowances.

## 3.3 Long list of options considered

Table 10: Longlist table

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| A: Do nothing **Rejected** | The network is kept in its current state, and no new connections are facilitated. | N/A | N/A | • **Contractual and Licence compliance:** Compliant customer connection not delivered, and it would be against our contractual and licence obligations. |
| B: Market-based solution **Rejected** | Increased customer demand is accommodated through the procurement and use of ancillary services only. | 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. |
| C: Whole systems solution **Rejected** | The required customer connection is accommodated by a DNO. | N/A | The volume of connections in the region would require extension regardless of site, carrying similar constraints as option E. | • **Contractual and Licence compliance:** Compliant customer connection not delivered, and the option does not comply with our licence obligations to provide connections<br>• **Deliverability:** Aberthaw requires intervention regardless of connection outcomes, and with customers located nearby there is no viable DNO capacity alternative, while any 132 kV demand transfer would be disadvantaged by non-aligned queues with the DNO prioritising its queue despite an earlier transmission application date. |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| Option D-1<br>**Taken Forward** | Utilise existing AIS substation with a "do minimum" approach.<br>[redacted] | [redacted] | • Planning permission may be required for SGT4, and SAB (SuDS) consent is needed for the new drainage system requiring new rights over the existing lease.<br>• Minor land acquisition and a new easement are needed, with no significant environmental constraints identified beyond potential contaminated land and any associated remediation. | • **Cost:** This option was taken forward on the basis that it would require the least intervention and likely be the lowest cost solution.<br>• **Engineering:** Doesn't fix core asset/operability limits and leaves no 132 kV headroom or spare bays.<br>• **Deliverability:** Requires exceptional, multi-year outages and bespoke procurement, with timescales comparable to rebuild. |
| Option D-2<br>**Rejected** | Utilise existing AIS substation, whilst providing a non-SF6 GIS or AIS extension for additional bays.<br>Requires uprating of<br>[redacted] | **Layout**:<br>[redacted] | • Planning permission and SAB (SuDS) consent are required, alongside new easement rights over the existing lease.<br>• This option has the largest land footprint, with no significant environmental constraints identified beyond potential contaminated land and any associated remediation from historical land use. | • **Engineering:** Some decoupling/futureproofing is possible, but legacy asset-health and end-of-life dependencies remain.<br>• **Deliverability:** Avoids bespoke plant and eases build via offline works, but a new site adds major programme complexity.<br>• **Economic / Consumer Value:** Discounted because this option loses key benefits post-connections reform and carries a new-site cost premium. |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| | | | | • **Consenting / Stakeholder:** Requires new land and consents, with no existing NGET land available. |
| Option E-1<br>**Rejected** | New substation build, AIS, cabled to existing OHL towers (assuming local site) | [redacted] | • Planning permission and SAB (SuDS) consent are required.<br>• The option needs 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 environmental impact. | • **Engineering:** Coastal pollution class IV and site constraints make GIS the viable, future-capable solution over AIS.<br>• **Environmental:** AIS increases land take/hedgerow impacts; GIS avoids escalation.<br>• **Deliverability:** AIS is flood/access/OHL-complex and delay-prone; GIS is simpler and lower risk.<br>• **Economic / Consumer Value:** GIS is lower-risk and more cost-effective than AIS.<br>• **Consenting / Stakeholder:** AIS triggers public right of way, residential and ancient monument consenting risk; GIS avoids. |
| Option E-2<br>**Taken forward** | New substation build, non-SF6 GIS, cabled to existing OHL towers (assuming local site) | [redacted] | • Planning permission and SAB (SuDS) consent are required.<br>• 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 environmental impact. | • **Engineering:** New build fixes legacy issues (including fault level) and enables futureproofing, but cables need proximity and add reactive power issues.<br>• **Deliverability:** Enables connections, but a new build drives programme risk and cable viability depends on being close to the existing site/OHL.<br>• **Economic / Consumer Value:** Cost is the main drawback especially for cables (high £/km) and added maintenance versus OHL diversion. |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| Option E-3<br>**Rejected** | New substation, AIS, OHL realignment to the rebuilt substation | [redacted] | • Planning permission and SAB (SuDS) consent are required, and >2 km of OHL works would trigger a DCO, adding ~2–3 years to the programme.<br>• 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 environmental impact. | • **Engineering:** Coastal pollution class IV and site constraints make GIS the viable, future-capable solution over AIS<br>• **Environmental:** AIS increases land take/hedgerow impacts; GIS avoids escalation<br>• **Deliverability:** AIS is flood/access/OHL-complex and delay-prone; GIS is simpler and lower risk.<br>• **Economic / Consumer Value:** GIS is lower-risk and more cost-effective than AIS.<br>• **Consenting / Stakeholder:** AIS triggers public right of way, residential and ancient monument consenting risk; GIS avoids |
| Option E-4<br>**Taken forward** | New substation, non-SF6 GIS, OHL realignment to the rebuilt substation | [redacted] | • Planning permission and SAB (SuDS) consent are required, and >2 km of OHL works would trigger a DCO, adding ~2–3 years to the programme.<br>• 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 environmental impact. | • **Economic/Consumer value:** As option E2, noting an OHL option provides cost-effective flexibility for locating further from OHL network and is preferred for future maintenance accessibility. |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| Option E-5<br>**Rejected** | New non-SF6 GIS substation – minimal land take. Phased build to allow for the demolition of old 275 kV and rebuild 132 kV in place |  | • Planning permission and SAB (SuDS) consent are required.<br>• Requires new land and new cable easement corridors; development on the existing power station site has minimal environmental constraints beyond potential contaminated land and associated remediation from historical land use. | • This option is based on the same principal as E1-4. The option however seeks to utilise existing NGET land at the expense of programme.<br>• **Engineering:** AIS will not fit, so the option is constrained to GIS.<br>• **Deliverability:** Reuse avoids new land but decommission/demolition doubles programme and adds complexity.<br>• **Economic / Consumer Value:** Despite favourable legacy terms and reduced land need, extra time/complexity/cost outweighs smaller land take, so this option is rejected.<br>• **Consenting / Stakeholder:** Less new land acquisition is required.<br>• **Environmental:** Smaller land take is a benefit, but not enough to justify the option. |
| Option E-6<br>**Rejected** | New non-SF6 GIS substation – minimum land take. Phased build to allow for demolition of old 132 kV first |  | • Planning permission and SAB (SuDS) consent are required, and >2 km of OHL works would trigger a DCO, adding ~2–3 years to the programme.<br>• 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 | • As option E5 but switching development with some additional land take due to the need to relocate SGTs first.<br>• This option was rejected for the same reasons as E5. |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| | | | have greater environmental impact. | |
| Option E-7 **Rejected** | New non-SF6 GIS substation, transmission voltage built at 400 kV, interbus transformers provided locally. | [redacted] | • Planning permission and SAB (SuDS) consent are required. S37 or NSIP consent required for 400 kV uprated lines. As no current driver can be demonstrated, this would not be achievable.<br>• The option needs new land and new cable/OHL easement corridors; the power station site has minimal environmental constraints beyond potential contaminated land/remediation, while siting interbuses locally will likely require greenfield land which would have greater environmental impact. | • **Engineering:** Complex interface to existing substation, ability to "extend" not possible increasing outage requirements. Siting interbuses any distance requires additional 400 kV towers or design assessment of L2 towers, potential use of retro-insulated cross-arms if innovation projects successful.<br>• **Deliverability:** Consenting requirements (e.g. NSIP), development delay to switch to 400 kV solution and procurement of five interbuses.<br>• **Economic / Consumer Value:** No driver identified in regional strategy requiring a 400 kV solution at Aberthaw. [redacted]<br>• **Consenting / Stakeholder:** Greater land acquisition is required. Interbuses locally would conflict with Lightsource land option [redacted] Increased consenting risk, e.g. cumulative EIA.<br>• **Environmental:** Greenfield land likely required. Additional transmission losses, oil requirements and capital carbon. |
| Option E-8 | New non-SF6 GIS substation, transmission | [redacted] | • Planning permission and SAB (SuDS) consent are required. S37 | • **Engineering:** Complex interface to existing substation, ability to "extend" not possible |

| Option | Technical Description | Relevant Diagrams or Layout References | Consenting Risks & Environmental Constraints | Rationale for rejecting or taking forward the option |
|---|---|---|---|---|
| **Rejected** | voltage built at 275 kV, interbuses provided locally or remotely, as required. | | or NSIP consent required for 400 kV uprated lines. As no current driver can be demonstrated, this would not be achievable.<br>• Consent likely to be future risk, as interbuses would not be provided today.<br>• The option needs new land and new cable/OHL easement corridors; the power station site has minimal environmental constraints beyond potential contaminated land/remediation, while siting interbuses locally could require greenfield land which would have greater environmental impact. It may be possible to site on the former 275 kV, but this would likely require additional circuit alteration. The remote end would be site dependant. | increasing outage requirements. Siting interbuses any distance requires additional 400 kV towers or design assessment of L2 towers, potential use of retro-insulated cross-arms if innovation projects successful.<br>• **Deliverability:** Consenting requirements (e.g. NSIP), development delay to switch to 400 kV solution and procurement of up to five interbuses.<br>• **Economic / Consumer Value:** [redacted]<br>• **Environmental:** Greenfield land may be required. Additional transmission losses, oil requirements and capital carbon. |

## Longlist evaluation

Based on the rationale explained in Table 10, we have discounted Options A, B and C because they will not allow us to facilitate the connection requests and consequently, we will not meet our contractual and licence obligations. Options E-7 and E-8 were discounted as there is no network requirement to provide a 400 kV connection, considering the additional cost or programme risk associated with these options. Option E-8 could be delivered in the future via remote interbus(es).

[redacted]

Option D-2 was discounted as it would not meet the asset health driver for this project. Options E-1 and E-3 were discounted as an AIS solution is not suitable for a site in close proximity to the coast (~0.5km) and would feature various consenting and program risk. Options E-5 and E-6 were also discounted at this stage due to the additional complexity, cost and program risk involved. Options D-1, E-2 and E-4 were progressed to the shortlist for their ability to meet the projects drivers.

### The addition of a further option because of early insights coming Connection Reform

At the point of submitting this Needs Case, the assessment of future connections under gate two phases one and two of Connections Reform was underway. Although not complete, the Batched Scheme Briefing Note (BSBN) issued by NESO provides a view of the likely future connections queue at Aberthaw. This has been reflected in the customer confidence data in section 2.1. In summary, our expectation is most generation customers (set out on section 2.1 above) will receive a gate one offer. This means there is no immediate driver to connect them.

[redacted]

Option E-6 (post reform), a variant of option D4, has been introduced as a new option, reflecting early insights from Connection Reform. This option prioritises the 132 kV GIS rebuild, with the 275 kV works intentionally delayed. The rationale for this sequencing stems from the designation of Strategic Demand and the South Wales Artificial Intelligence Growth Zone (AIGZ) for 2030, as well as a reduction in the benefits associated with lost generation at 275 kV. [redacted] By advancing the 132 kV buildout, commissioning programmes and resource requirements are reduced. The smaller scope mitigates up-front risk, which could otherwise delay the energisation of 132 kV compared to full build options E-1 to E-4.

In summary, retrospective options have been reviewed alongside detailed historical optioneering, with option E-6 (post reform), prioritising the 132 kV GIS rebuild and delaying the 275 kV build emerging as a key alternative.

## Stakeholder influence on shortlisting

[redacted]

## DNO and Third-Party Works

[redacted]

NGET's confidence in the TPW cost estimate was low: the quote assumed additional feeder bays at GSPs with available capacity yet [redacted]

- **DNO1** [redacted]
- **DNO2:** Network split at 132 kV level – i.e. there would be two Aberthaw 132 kV substations. One, NGET owned and operated as an infrastructure site. The Second, NGED owned and operated, fed by connection asset SGTs.
- **DNO3:** As DNO2, however the substation would not be immediately split. Provides an insurance policy should NGET or NGED connection queues significantly alter removing the need to works.

**DNO2** was selected as the preferred option because it represents best whole-system value, provides a stronger ACL and cost certainty.



NGED are currently undertaking optioneering on their replacement 132 kV substation and are understood to be drafting their RIIO-ED3 Engineering Justification Paper for submission later this year. As a result, scope and cost of the NGED development are out of scope for this paper.

For the preferred option, NGET have sought to provide provision for the replacement NGED GIS substation within the acquisition and development footprint. This is to ensure that a viable point of connection remains available to NGED whilst they explore their full optioneering process, considering technology type and land available. As a result, the scheme costs do include land acquisition, basic construction platform and drainage provision for the development for NGED. Should NGED not utilise this land, NGET anticipate its retention after use for construction as future maintenance laydown and are consenting as a storage/laydown area.

## 3.4 Shortlisted options

The shortlisted options for Aberthaw 275/132 kV are:

- Option D-1: Do minimum works, utilising spare bays at existing AIS substation
- Option E-2: New substation build, non-SF6 GIS, cabled to existing OHL towers (assuming local site)
- Option E-4: New substation, non-SF6 GIS, OHL realignment to the rebuilt substation
- Option E-6: Prioritisation of 132 kV non-SF6 GIS rebuild, with a delayed 275 kV build

### Description of short-list options considered

**Option D-1 Do minimum works, utilising spare bays at existing AIS substation**

[redacted]





**Option E-2: New substation build, GIS, cabled to existing OHL towers (assuming local site)**



[redacted]





**Option E-4 New substation, GIS, OHL realignment to the rebuilt substation**





[redacted]



The System Design Table included in Appendix B demonstrates how the system design of the above shortlisted options has been considered in meeting the investment drivers of the project.

## 3.5 Detailed qualitative analysis of shortlisted options

Table 11, below, provides a summary of our detailed qualitative assessment of the optioneering categories; engineering, environmental, deliverability, economic & consumer value and consenting & stakeholder impact, for the four shortlisted options.

Table 11: Detailed qualitative assessment table for shortlisted options

| Option | Optioneering Categories | | | | |
|---|---|---|---|---|---|
| | **Engineering** | **Environmental** | **Deliverability** | **Economic/Consumer Value** | **Consenting /Stakeholder** |
| **Option D-1: Do minimum works, utilising spare bays at existing AIS substation** | • Delivered on the existing Aberthaw sites using remaining spare bays, with no OHL works, but it does not provide future-proofing.<br>• Accommodatin [redacted] would require off-site works, and some site expansion or cable diversions may be needed.<br>• Refurbishment would be complex on a live site and may still not achieve a further 40-year life; bespoke plant, safety clearance issues, fault-level constraints and maintenance limitations remain. | • Re-use of the existing civil infrastructure and AIS plant gives the lowest upfront construction carbon.<br>• Development on the existing site avoids direct ecology and ecosystem impacts.<br>• Limited future-proofing could constrain future low-carbon connections in the area | • Limited offline build opportunities mean an extremely high live-site outage and resource burden.<br>• SGT uprating and 132 kV post-insulator replacement would require multiple outage seasons, delaying delivery of full capacity.<br>• Bespoke 275 kV breaker procurement and major roof/cladding works add further programme risk. | • Lowest upfront capex, but there is a material risk of early write-off and higher future opex if the legacy site cannot reasonably be extended to the required life.<br>• Significant outages and deferred maintenance across the Cardiff demand group could create additional, unquantified DNO costs.<br>• The indoor AIS arrangement would continue to impose a relatively high maintenance and outage burden | • Still requires new land and consents for SGT4, with possible site boundary expansion. [redacted]<br>• DNO outage constraints would be significant during post-insulator replacement works. |
| | Strong Detractor | Detractor (no future connections) | Strong Detractor | Neutral | Benefit |
| **Option E-2: New substation build, GIS, cabled to existing OHL towers** | • A new GIS build can be designed to modern standards and offers greater routing flexibility through cables.<br>• The cabled solution introduces more interface complexity, including cable crossings, longer cable design considerations, and potentially an interconnector to support transfers from the legacy site. | • Compared with an OHL solution, the cabled option is likely to have higher carbon and ecosystem impacts because of greater civil works and footprint.<br>• It may offer longer-term visual benefits. | • Requires new land and consents, extending the development programme, although cables may benefit from PD rights.<br>• Removes many dependencies on the existing site, but dual operation would still be | • Higher cost than D-1 and higher than E-4, with cable length being a key cost driver.<br>• Whole-life opex is higher for cables, and some site variants could also create ongoing sea-defence liabilities. | [redacted]<br>Planning and new land are still required, [redacted] |

| | | | | | |
|---|---|---|---|---|---|
| **(assuming local site)** | • Final site conditions may still require mitigation for issues such as contamination, piling, historic buried infrastructure, flood defence and maintenance access. | • Environmental effects remain site-dependent, and any contaminated ground would require careful design treatment. | needed until DNO transfers are complete.<br>• GIS lead times and cable-route complexity could add programme risk, albeit with lower outage/resource requirements than D-1. | • It does, however, provide future-proofing for spare bays and future capacity growth. | • DNO preferences and the user connection boundary remain important design considerations. |
| | Benefit | Detractor | Neutral | Detractor | Neutral |
| **Option E-4: New substation, GIS, OHL realignment to the rebuilt substation** | • A new GIS/OHL build can be designed to modern standards and has less interaction with customer and DNO buried cables.<br>• Relative to a cabled option, OHL is generally simpler to build and operate and is easier to future-proof for later 275 kV reinforcement.<br>• Some complexity remains around legacy site interfacing and site-specific ground/access conditions, but overall, the design is more straightforward than the staged or heavily cabled alternatives | • Lower carbon footprint than the cabled alternative, with scope to adjust tower placement sensitively.<br>• Brownfield options are available, although local impacts will still depend on the final siting.<br>• Vegetation management may be required if woodland is oversailed. | • Requires new land and consents, and OHL consents add programme risk.<br>• Dual operation would still be required, but it avoids the cable-route complexity of E-2 and has lower outage/resource requirements than D-1.<br>• GIS lead times still need to be managed, although the initial civils programme should be faster. | • Higher cost than D-1, but lower than E-2, with no cable-driven whole-life opex burden.<br>• Whole-life maintenance costs are lower for OHL than for cables; some AIS variants could still introduce sea-defence liabilities.<br>• Option E-4 is designed to accommodate future growth by providing spare and populated GIS bays at 132 kV and 275 kV, reserving space for [redacted] enabling flexible future switching arrangements, and incorporating preparatory ducting, civil works and uprating-ready OHL/tower design to minimise future rework, outages and whole-life cost. | • OHL realignment requires additional S37 consents and could create DCO/NSIP risk, although this is mitigated by the local routing.<br>• Visual change is relatively limited where the OHL is realigned to the preferred site.<br>• Planning and land requirements still apply, [redacted] |
| | Benefit | Neutral | Neutral | Neutral | Neutral |

| | | | | | |
|---|---|---|---|---|---|
| **Option E-6: Prioritisation of 132 kV GIS rebuild, with a delayed 275 kV build** | • Prioritising the 132 kV build addresses an immediate need, but the staged approach introduces greater engineering complexity, including double circuit transfers and continued interfacing with the existing site.<br>• The final OHL/cabling arrangement remains to be defined, and local siting is required because long SGT LV cable runs are not viable.<br>• Bespoke 275 kV plant, safety clearance measures and maintenance access considerations would still remain. | • This has the highest carbon impact of the rebuild options because it combines a new build with additional interface works to the existing AIS.<br>• It is still likely to be on brownfield land, limiting direct ecology impacts. | • Prioritising the 132 kV build could reduce near-term asset risk and defer some 275 kV consenting requirements.<br>• However, the staged approach extends the overall programme, still requires new land/consents, and remains exposed to GIS and bespoke plant lead times.<br>• It offers more flexibility on the timing of the 275 kV build, but at the cost of added staging complexity. | • Highest-cost option of the shortlist.<br>• It could connect strategic demand earlier, but this comes at the expense of the timing of low-carbon generation connections.<br>• The staged approach may preserve some flexibility to revise the later 275 kV build, subject to land availability and wider redevelopment. | [redacted] Staged delivery [redacted]<br>• The longer construction programme [redacted]<br>• [redacted] |
| | Strong detractor | Detractor | Benefit | Detractor | Detractor |

Based on the qualitative assessment above, our preferred design is option E-4 because it offers the clearest balance between deliverability, futureproofing and consumer value, while avoiding the drawbacks associated with refurbishing the legacy site, relying on extensive cabling, or adopting a more complex staged delivery strategy.

### PASE alignment

The PASE guidance doesn't consider 275 kV infrastructure therefore this investment cannot be assessed for PASE compliance. However, should in future, PASE expand to cover 275 kV infrastructure then this investment would comply as a as a variant option as an Indoor Double Busbar GIS near the coast.

We consider this approach justified, as 275 kV is the most appropriate voltage at this time. NGET's regional studies confirm that targeted reinforcement and futureproofing of the existing 275 kV network will adequately support Aberthaw's contracted connection, asset health and operational requirements, representing the most proportionate and least-regret option for consumers.

## 3.6 Detailed Quantitative Analysis of Shortlisted Options

### Cost Estimates of shortlisted options

[redacted]

The cost estimates presented in section 3.6 include the estimated cost of DNO2, ensuring that the total estimated cost of each shortlisted option is assessed on a consistent basis. A detailed summary of the Third-Party Works required to deliver the preferred solution at Aberthaw can be found in the DNO and third-party works section. Appendix D sets out the supporting optioneering analysis, which demonstrates that the estimated cost of DNO2 is efficient, proportionate and represents the best value outcome for consumers.

Table 12: Cost estimate of works (2023/2024 base prices)

| Unit | Option D-1 Cost (£m) | Option E-2 Cost (£m) | Option E-4 Cost (£m) | Option E-6 Cost (£m) |
|---|---|---|---|---|
| [redacted] | [redacted] | [redacted] | [redacted] | [redacted] |

#### Cost Drivers

The project's cost estimates are based on current market conditions, with ongoing work to refine requirements. The baseline funding request is supported by high-cost confidence and robust EUL (Estimating Units Lines) assessments.

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

- Cable and OHL lengths across all options
- For GIS layouts, gas insulated busbars compared to cable lengths
- Overall civil input and asset quantities, particularly between do minimum and rebuild options

# Cost Benefit Analysis

### Purpose and Approach

Our Cost Benefit Analysis (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, operational and maintenance costs, 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 solution 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 CAPEX investment required
- Future end of life replacement costs

The supporting CBA model quantifies the costs and benefits for this project. Using the Ofgem RIIO-ET3 CBA template spreadsheet, the CBA includes the following four shortlisted options:

- Option D-1: Do minimum works, utilising spare bays at existing AIS substation
- Option E-2: New substation build, GIS, cabled to existing OHL towers (assuming local site)
- Option E-4: New substation, GIS, OHL realignment to the rebuilt substation
- Option E-6: Prioritisation of 132 kV GIS rebuild, with a delayed 275 kV build

### 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 cost-benefit analysis (2023/2024 base prices, central carbon pricing, discounted values)

| [redacted] | Initial Investment [redacted] | PV of Lifetime Costs (£m) | PV of Monetised Benefits (£m) | NPV (£m) |
|---|---|---|---|---|
| [redacted] | | | | |
| [redacted] | | | | |
| [redacted] | | | | |
| [redacted] | | | | |

On the basis of the discounted lifetime CBA results (Table 14), option D-1 delivers the highest NPV ([redacted] 2023/2024 base prices), option [redacted]. This analysis is subject to confirmation through deliverability, consents/land, outage and risk considerations, and any CBA sensitivities set out in the assumptions below.

### Assumptions of the CBA analysis

Core assumptions and sensitivities. 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.
- Price base: 2023/2024 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 and opex costs (2023/2024 base prices)

| Option | Total CAPEX (£m) | | |
|---|---|---|---|
| | Initial CAPEX (£m) | Future replacement (40 yr) (£m) | Total (£m) |
| Option D-1 | [redacted] | [redacted] | [redacted] |
| Option E-2 | [redacted] | [redacted] | [redacted] |
| Option E-4 | [redacted] | [redacted] | [redacted] |
| Option E-6 | [redacted] | [redacted] | [redacted] |

Option D-1 is the lowest capex cost, making it the most cost-effective option. Option E-2 is the most expensive option due to the additional cable length required. The total difference in costs as per Table 15 between option D-1 and E-2 is approximately [redacted] Options E-2 and E-4 have a small difference in their total cost.

### Benefits

The following benefits have been included within the CBA:

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

Table 16 presents the summary of all (undiscounted) benefits, including environmental and non-environmental benefits, considering the central base case carbon price.

| Option | [redacted] | [redacted] | [redacted] | [redacted] |
|---|---|---|---|---|
| Option D-1 | [redacted] | [redacted] | [redacted] | [redacted] |
| Option E-2 | [redacted] | [redacted] | [redacted] | [redacted] |
| Option E-4 | [redacted] | [redacted] | [redacted] | [redacted] |
| Option E-6 | [redacted] | [redacted] | [redacted] | [redacted] |

The lifetime costs and benefits refer to a 40-year period starting from 2027 until 2076. A summary of lifetime CBA results and their apportionment across T3 and T4 is presented in Table 14. Costs and benefits are discounted and presented relative to the baseline option counterfactual.

## 3.7 Preferred Solution

Although option D-1 has the highest NPV in Table 14, we consider that option E-4: New substation, GIS, OHL realignment to the rebuilt substation is the preferred option for Aberthaw 275/132 kV when the CBA and qualitative assessment are considered together. Option D-1 is not preferred because it would deliver the required capacity by extending reliance on ageing 132 kV and 275 kV AIS infrastructure with known asset health, safety, outage, maintainability and resilience risks. These asset health risks that are prevalent at the existing site are included in section 2.2 of this submission. Achieving a further 40-year life through refurbishment is considered unlikely and would require complex works on, or adjacent to, a live operational substation, including bespoke plant, enabling works and additional safety controls. It would also retain key constraints, including limited fault level headroom, restricted plant access, working at height challenges and structurally embedded through-floor bushings.

By contrast, option E-4 provides a durable and strategically aligned solution that addresses the immediate customer connection requirement, resolves the underlying asset health challenges, provides for future capacity and avoids further long-life investment in constrained legacy assets. While option E-4 has a lower NPV than option D-1, it provides a stronger overall balance of deliverability, resilience, futureproofing and consumer value. On this basis, option E-4 is considered the most robust and appropriate long-term solution for Aberthaw.

Table 17 below summarises the qualitative assessment supporting the selection of option E-4 as the preferred option, notwithstanding that option D-1 has the highest modelled NPV.

Table 16: Qualitative comparison of options D-1 and E-4

| Option | Cost | NPV | Advantages of this option | Disadvantages of this option |
|---|---|---|---|---|
| **D-1: Use spare bays at existing AIS substations** | [redacted] | [redacted] | • Highest modelled NPV and materially lower upfront cost than E-4.<br>• Makes use of existing spare AIS bays<br>• Could provide near-term electrical capacity without a full substation rebuild. | • Relies on ageing AIS infrastructure with material asset health, safety, outage, maintainability and resilience risks.<br>• Requires complex live-site refurbishment, bespoke plant and enabling works, with achieving a further 40-year life considered unlikely.<br>• Retains key operational constraints, including limited fault level headroom, working at height issues, restricted access to plant and additional 275 kV safety controls.<br>• Provides limited futureproofing and could expose consumers to greater whole-life cost, outage and rework risk. |
| **E-4: New substation, GIS, OHL realignment to the rebuilt substation** | [redacted] | [redacted] | • Addresses the key scope drivers by delivering customer connections, resolving asset health challenges and providing future capacity.<br>• Provides a durable, strategically aligned solution that removes reliance on ageing AIS infrastructure and avoids key legacy-site risks.<br>• Uses non-SF6 GIS to minimise land take, reduce environmental impact and improve deliverability compared with AIS options.<br>• Offers the best overall balance of NPV, qualitative performance, resilience, futureproofing and consumer value. | • Lower modelled NPV than D-1, meaning it is not the highest-ranked option on CBA alone.<br>• Higher upfront cost than using existing spare AIS bays.<br>• Requires more substantive construction activity, including a new GIS substation and OHL realignment.<br>• Requires investment ahead of some longer-term benefits being realised, particularly future capacity and strategic optionality. |
| **Difference:** | [redacted] | | | |

## Project Benefits & Outputs

The preferred option for this project is option E-4: a new GIS 275 / 132 kV substation.

The key outputs and benefits delivered by this option, and how they align to the pillars of our ambition for RIIO-ET3 are as follows:

Table 17: Summary of outputs and benefits

| | |
|---|---|
| **Output & Proposed PCD** | The delivery of a new GIS 275/132 kV substation, enabling contracted connections and asset health improvements by 2033 (this includes final energisation, completion of circuit transfers and DNO transfer). |

- Rebuild 1950s–60s substations with a future-ready design to meet forecast capacity and accommodate growth (data centres, transport/heat electrification), with headroom for new generation.
- Where OHLs are re [redacted]
- Use objective socio-economic assessment in site selection to balance environment, community and consumer impacts on a future-proof site.
- Remove installed SF6 from the network.
- [redacted]

# 4. Delivery

A programme of works for option E-4: a new GIS 275 / 132 kV substation, is outlined below in Figure 17. This illustrates the key milestones for Customer, National Grid, Murphy and Regulation critical pathways.



## 4.1 Procurement & contracting strategies





## 4.2 Risk & risk management

Through SWOT analysis we have identified the preferred option does still present some risks; these are also listed in the CBA summary. Refer to the high-level risk assessment and associated mitigation in Table 19 below.

A full qualitative Risk Assessment will be carried out prior to contract award with the EPC Contractor, with the output updated accordingly.

Table 19: Risk Summary Table

| Category | Risk | Mitigation Measure |
|---|---|---|
| **Design & Technical Complexities** | • Unforeseen ground conditions, buried services or unsuitable site infrastructure<br>• Inaccurate or incomplete site information | • Complete early investigations and utility surveys to de-risk design and construction<br>• Update drawings and technical assumptions using verified survey data |
| **Planning, Land & Consent** | • Land acquisition dependency and [redacted] landowner control<br>• Consenting delay from OHL works, layout changes or DCO risk | [redacted]<br>• Optimise siting and design to minimise OHL works and consenting complexity. |
| **Thid Party Impact & Network Co-ordination** | • Needs case or futureproofing challenge during Project Assessment<br>• Missed customer connection dates due to third-party dependencies<br>• Changing customer landscape due to Connections Reform. | • Retain future capacity through reserved bays and space for additional SGTs<br>• Decouple delivery where possible through split GSP and flexible sequencing.<br>• Secure cost certainty of costs post-connections reform before Project Assessment |
| **Timing of Programme & Resources** | • Outage availability and programme disruption<br>• Long-lead items, SAP resource and supply chain constraints | • Engage NESO early, secure outages and maintain programme float.<br>• Procure critical items early and ringfence key delivery resources. |
| **Cost** | • Cost uncertainty from estimates, contract mechanisms and inflation<br>• Exposure to third-party cost increases, including DNO LV supply<br>• Cost uncertainty due to timing of existing site demolition. | • Refine estimates, apply early contractor input and secure cost certainty early.<br>• Align customer securities and project spend to protect consumers.<br>• Demolition surveys undertaken during ECI Stage 1 to refine cost estimate.<br>• Project Assessment submission timing will depend on the determination of our planning submission, as this will outline additional constraints and certainty of the DNO's programme. |

# 5. Conclusion

This Track 3 Needs Case outlines the investment needs for a [redacted]

The proposed solution is option E-4: a new GIS 275 / 132 kV substation. Option E-4 is the most economical solution overall and will enable NGET to satisfy all contracted connections, whilst also offering optionality for future extendibility.

There are known uncertainties and risks associated with option E-4 that have been captured in this Load Reopener, such as supply chain, land contamination and consenting risks. To ensure our successful delivery of this project, collaboration with all stakeholders involved in the proposed investment and within the Aberthaw site is critical.

This submission outlines a preferred solution to satisfy the investment drivers. It seeks formal approval of the needs case and our preferred option. The Price Control Deliverable (£m) associated with this investment proposal is as follows:

Table 20: Investment summary

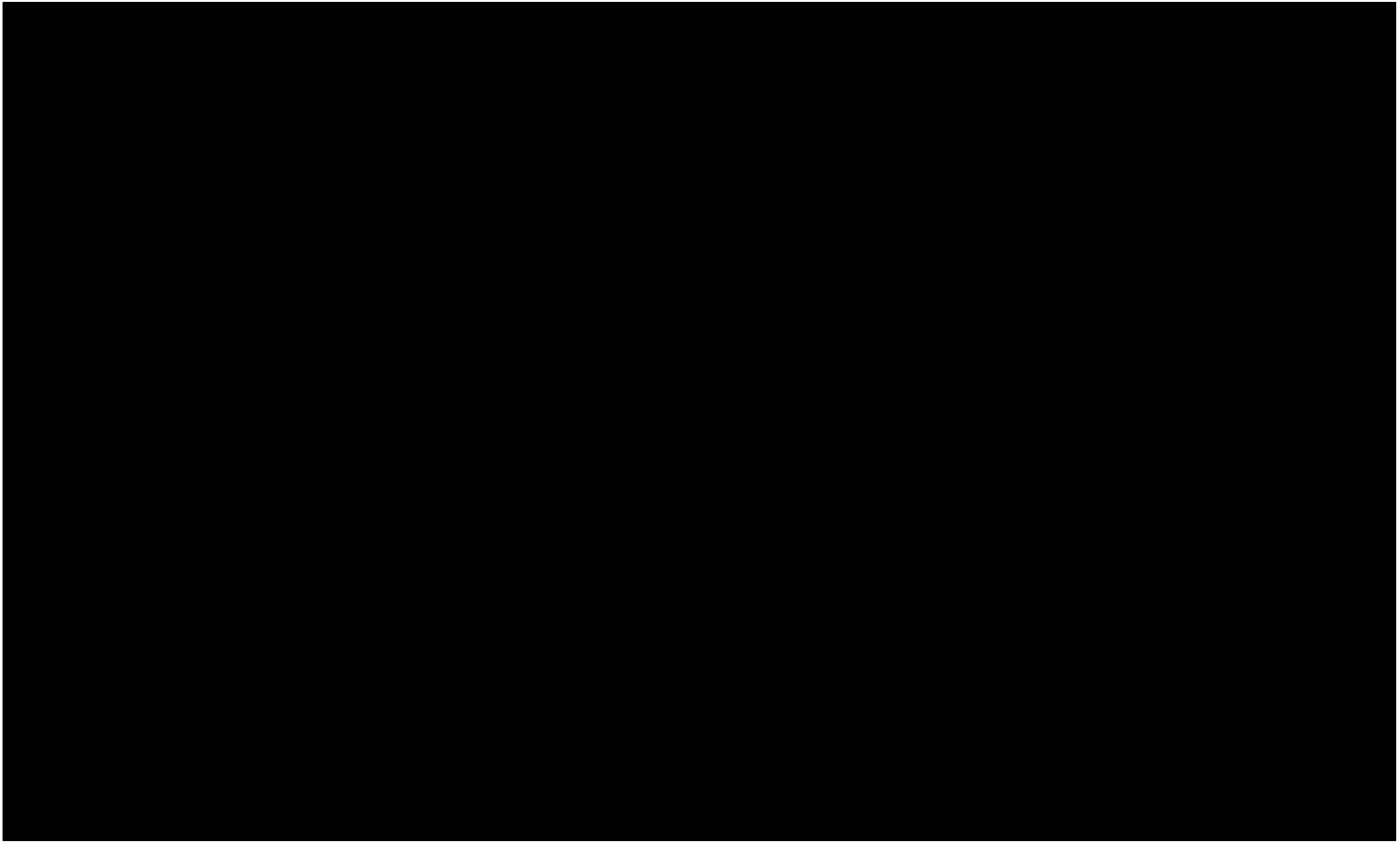
| | |
|---|---|
| **Main Drivers** | **Primary investment driver for the Aberthaw project are customer connections.** [redacted]<br>**Primary investment driver for the Aberthaw project is asset health**, associated with the 1950s and 1960s substations, notably the 132 kV which require significant outages and capital investment to resolve. These considerations would be compounded by new customer works. |
| **Selected Option** | The proposed solution is option E-4: a new GIS 275 / 132 kV substation. |
| **Estimated Cost & Timing** | **Estimated capital cost:** £[redacted] prices, inc. Risk & contingency)<br>The delivery milestones for this project are:<br>• [redacted]<br>• [redacted]<br>• October 2033: Final energisation, completion of circuit transfers and DNO transfer<br>Dates are subject to procurement, contractor programme and confirmation of DNO programme. |
| **Outputs** | The preferred investment at Aberthaw will deliver key outputs for consumers and the wider network by rebuilding the 275/132 kV substation and facilitating Third Party Works.<br>The investment at Aberthaw includes the [redacted] |

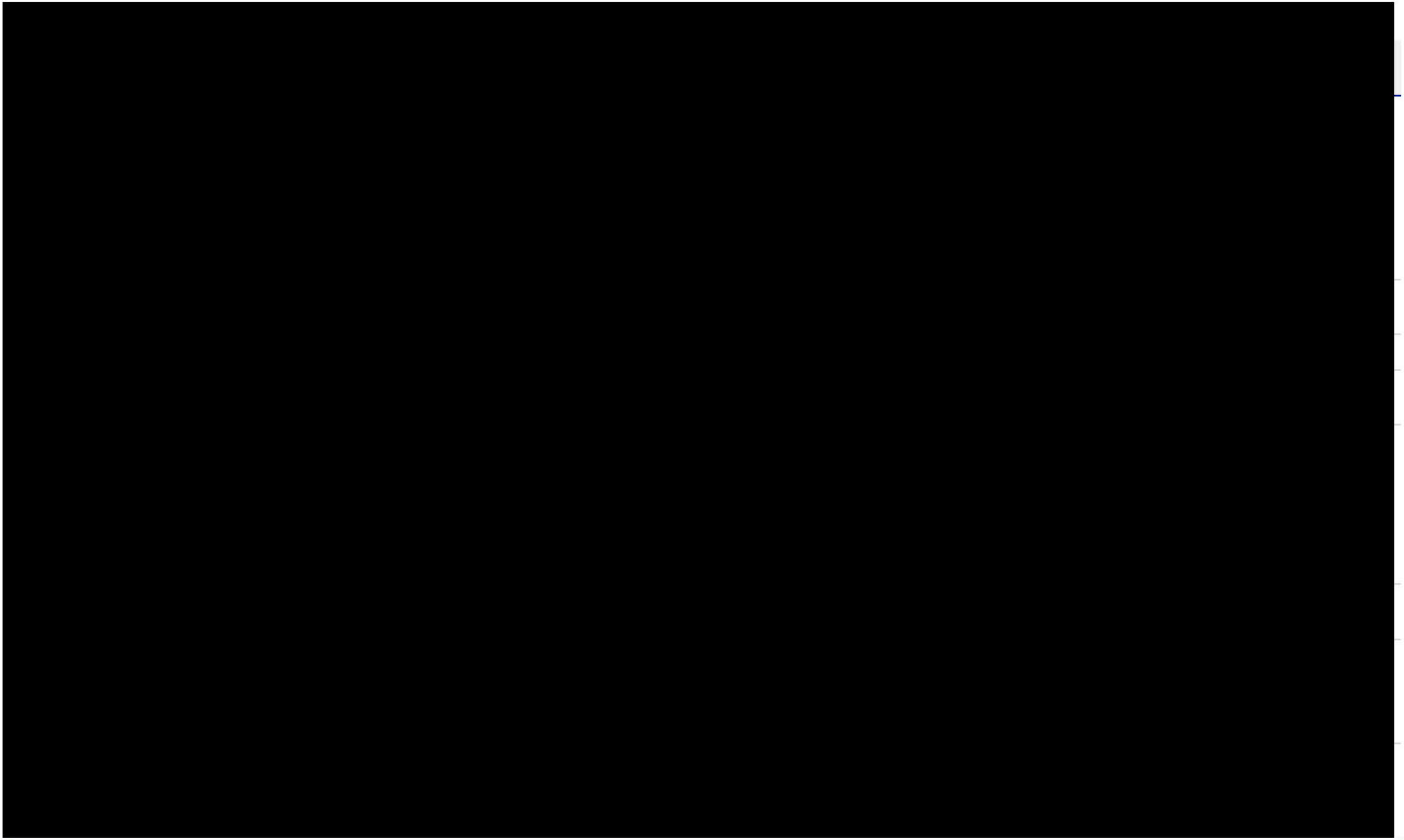
# Appendix A: Glossary

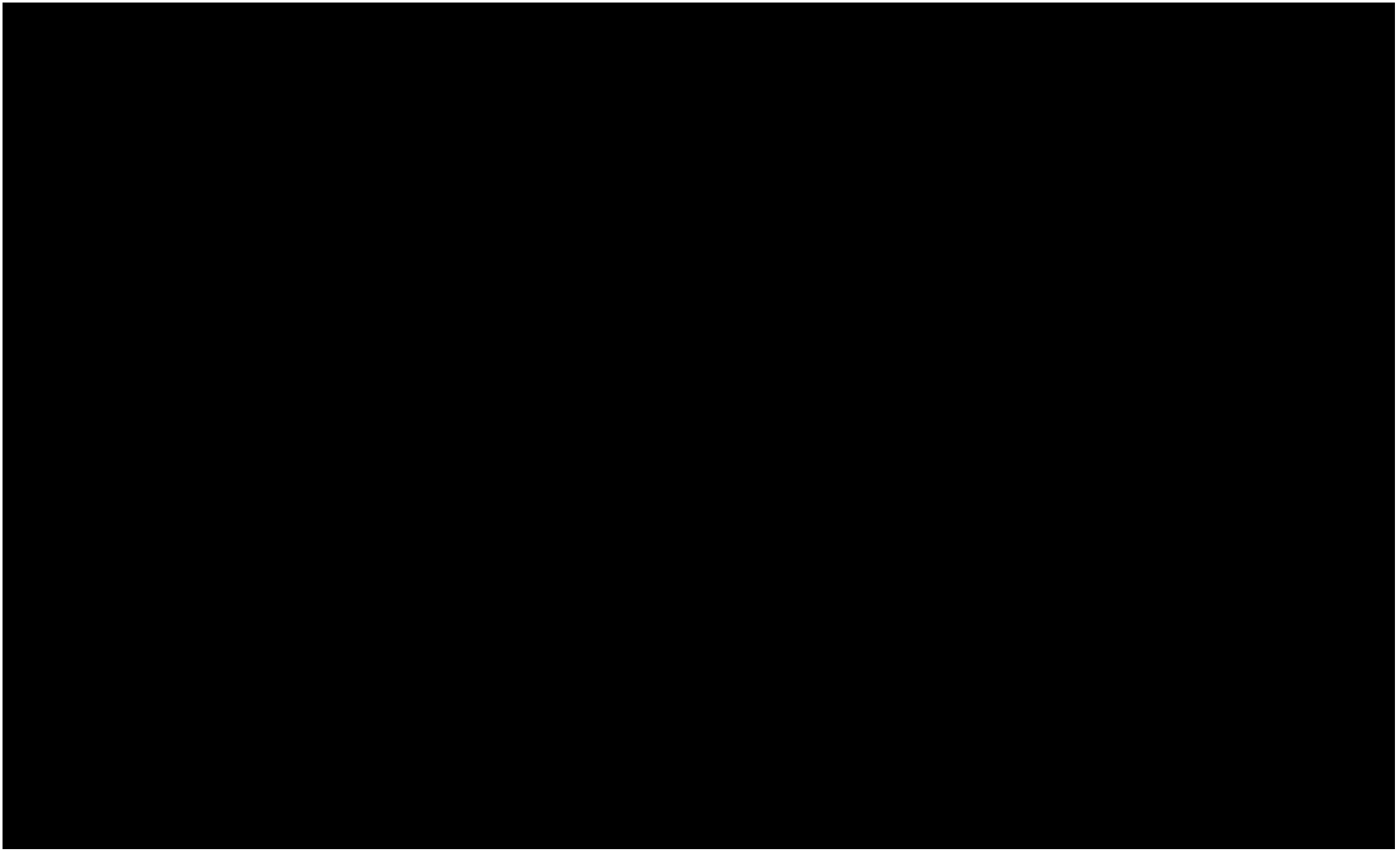
| Abbreviation | Description |
|---|---|
| ACL | Available For Commercial Load |
| ACSR | Aluminium Core Steel Reinforced |
| AIS | Air Insulated Switchgear |
| APM | Advanced Procurement Mechanism |
| BESS | Battery Energy Storage System |
| BP | Business Plan |
| BPDT | Business Plan Data Template |
| CAI | Closely Associated Indirect |
| CBA | Cost Benefit Analysis |
| CPO | Compulsory Purchase Order |
| CSNP | Centralised Strategic Network Plan |
| DC | Direct Current |
| DCO | Development Consent Order |
| DC TC | Direct Current Time Constraint |
| DESNZ | Department for Energy Security and Net Zero |
| DISC | Disconnector |
| DLR | Docklands Light Railway |
| DNO | Distribution Network Operator |
| ECC | Estimated Cost of Construction |
| EEW | [redacted] |
| EJP | Engineering Justification Paper |
| EoL | End-Of-Life |
| ESO | Energy System Operator |
| ET | Electricity Transmission |
| EU | European Union |
| EUL | Estimating Units Lines |
| ESW | Earth Switch |

| Abbreviation | Description |
|---|---|
| FEED | Front End Engineering Design |
| FES | Future Energy Scenarios |
| FY | Financial Year |
| G3 | Green Gas for Grid |
| GEC | General Electric Company |
| GIB | Gas Insulated Busbar |
| GIS | Gas Insulated Switchgear |
| GLA | Greater London Authority |
| GW | Giga Watt |
| HDD | Horizontal Directional Drilling |
| HV | High Voltage |
| HWUP | Hackney Waltham Cross Uprating |
| IEC | International Electrotechnical Commission |
| ISS | Integrated Security System |
| kW | Kilo Watt |
| LLTI | Long Lead Time Items |
| LTDS | Long-Term Development Statement |
| LV | Low Voltage |
| LVAC | Low Voltage Ac |
| M&E | Mechanical And Electrical |
| MITS | Main Interconnected Transmission Systems |
| MSIP | Medium Sized Investment Project |
| MVA | Megavolt-Amperes |
| MW | Mega Watt |
| NESO | National Energy System Operator |
| NETS | National Electricity Transmission System |
| NG | National Grid |
| NGED | National Grid Electricity Distribution |
| NGET | National Grid Electricity Transmission |

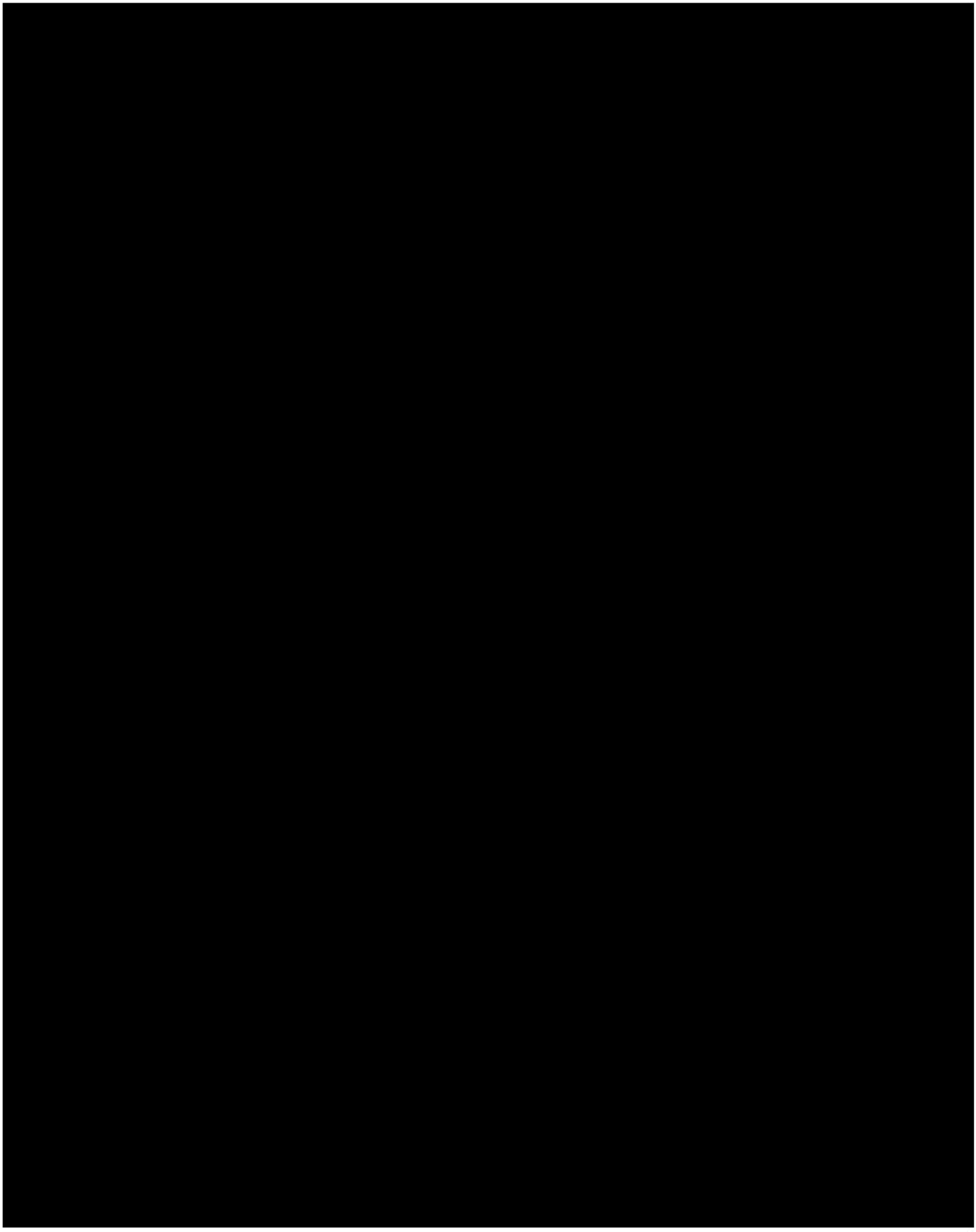
| Abbreviation | Description |
|---|---|
| NOA | Network Options Assessment |
| NOMs | Network Output Measures |
| NPV | Net Present Value |
| OHL | Overhead Line |
| ORPS | Obligatory Reactive Power Service |
| PCD | Price Control Deliverables |
| PCF | Pre-Construction Funding |
| SF6 | Sulfur Hexafluoride |
| SGT | Super Grid Transformer |
| SLD | Single Line Diagram |
| SPV | Special Purpose Vehicle |
| SSMD | Sector Specific Methodology Document |
| SSSI | Site of Special Scientific Interest |
| STC | System Operator Transmission Owner Code |
| SuDS | Sustainable Drainage Solutions |
| TBC | To Be Confirmed |
| tCO2e | Tonnes of Carbon Dioxide Equivalent |
| TCPA | Town And Country Planning Association |
| TCSNP | Transitional Centralised Strategic Network Plan |
| TWB | Through-Wall Bushing |
| UK | United Kingdom |
| UKPN | UK Power Networks |
| UKPN EPN | Eastern Power Networks |
| UKPN LPN | London Power Networks |
| UKPNS | UK Power Networks Services |
| UXO | Unexploded Ordnance |
| VCA | Voltage Compliance Assessment |
| XLPE | Cross-Linked Polyethylene |

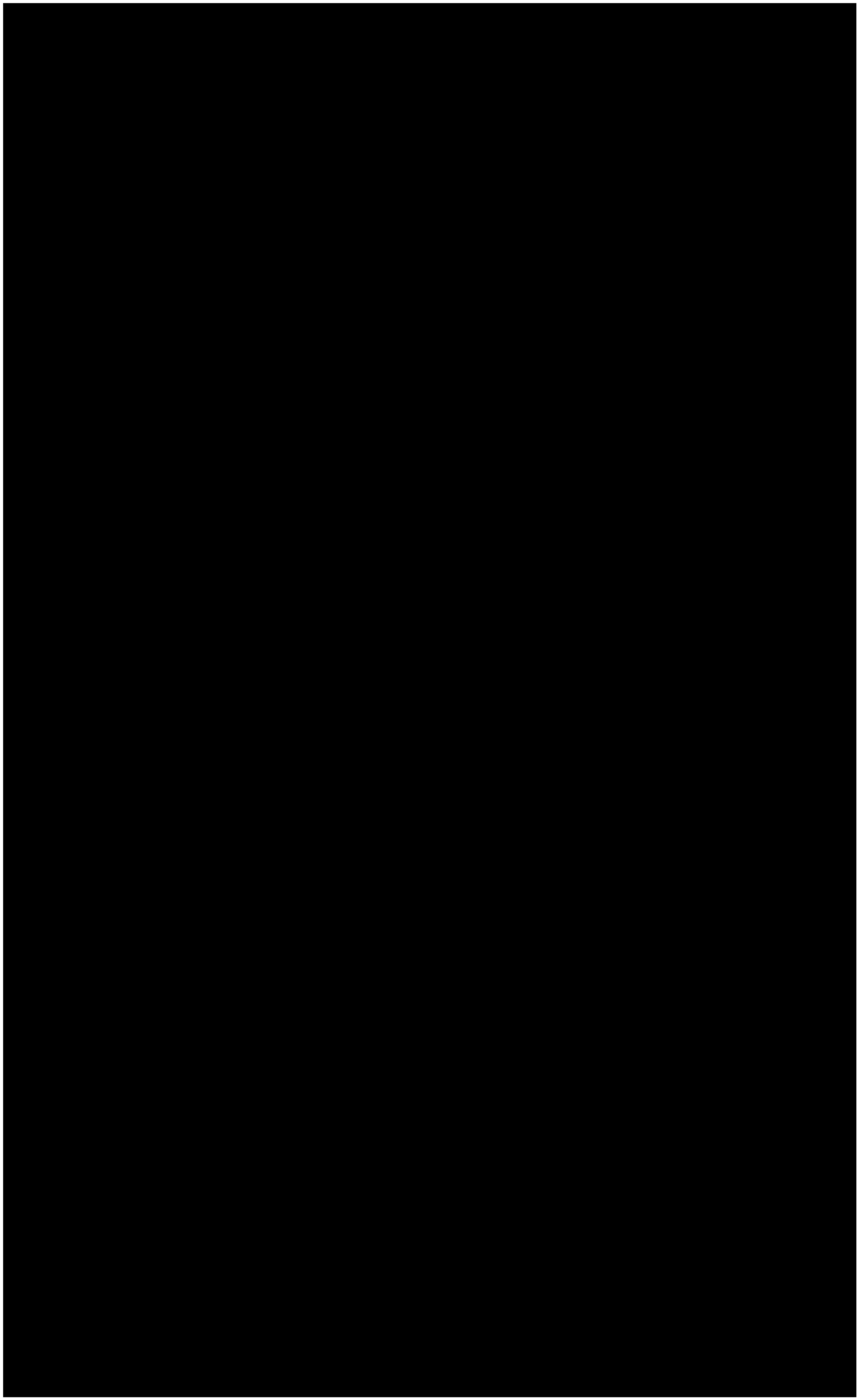






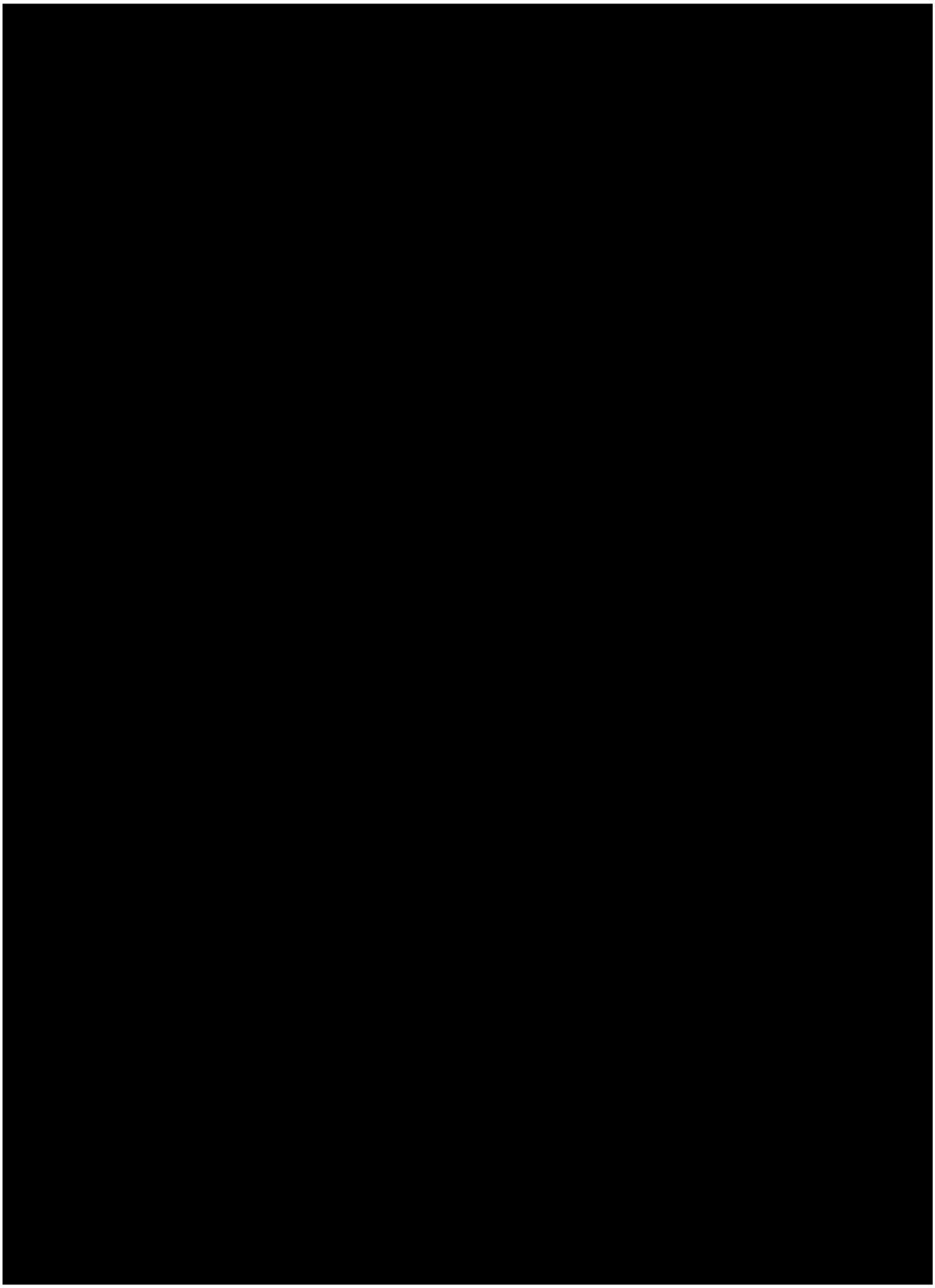












# Appendix E:
# Third Party Works - Optioneering Analysis

To accommodate the 132 kV demand customers at [redacted] Third Party Works were triggered at the 132 kV. This involved a decision to split the either the Cardiff NGED network or the Aberthaw 132 kV network. The intent of the TPW process is to have customers pay for localised upgrades. Given the significant work triggered by customers here, an in-depth assessment was undertaken to identify if undertaking this work had whole system benefits.

Table 23: Optioneering analysis for third party works

| DNO Options | Option description | Preferred Option | Rationale |
|---|---|---|---|
| DNO1 | Do Nothing - Customer triggering Third Party Works [redacted] | Discounted | • **Whole-system cost**: [redacted] but relies on uncertain assumptions (e.g., an additional feeder bay at a substation already at capacity); costs likely to rise due to BSP extensions or new sites<br>• [redacted]<br>• **Network impact**: Significant investment to split the group, reducing resilience, security and future demand headroom.<br>• [redacted]<br>• **Evidence**: NGED provided a formal report for the Ofgem funding submission. |
| DNO2 | Network split at 132 kV level – i.e. there would be two Aberthaw 132 kV substations. One, NGET owned and operated as an infrastructure site. The Second, NGED owned and operated, fed by connection asset SGTs. | Selected | • Selected with NGED and customers as the best whole-system value, aligning with Ofgem's whole-system approach.<br>• Addresses the reasons for discounting DNO1 and provides stronger ACL and cost certainty.<br>• Consumer-funded (NGET infrastructure + DNO connection assets)<br>• [redacted] |

| DNO Options | Option description | Preferred Option | Rationale |
|---|---|---|---|
| | | | [redacted] |
| DNO3 | As DNO2, however the substation would not be immediately split. Provides an insurance policy should NGET or NGED connection queues significantly alter removing the need to works. | Discounted | • To mitigate the risk of customer termination stranding significant investment, a future split was considered.<br>• [redacted] than DNO2 (due to works to enable a future split)<br>• CBA break-even ≈2030, which is not persuasive given strong confidence in Bro Tathan and Vantage Data Centres. |

A CBA was undertaken as a sensitivity analysis to consider NPV DNO3 [redacted]

Table 24 below provides a summary of the NPV's for the three TPW options.

Table 24: CBA output for third party works

| Option | Total Additional Cost | NPV | NGET Infra-structure | NGET Connection | NGED Funded | TPW User | [redacted] |
|---|---|---|---|---|---|---|---|
| [redacted] | | | | | | | |

[redacted]

These costs have also been applied to the DNO quote for consistency of approach.

Of the two remaining options, DNO2 was selected (Aberthaw GSP split). This was considered to have the following advantages over DNO1:

- [redacted]
- Doubt that [redacted] saving of the alternative option would be realised, due to high degree of risk from assumptions in the DNO quote.
- A DNO level split would adversely affect the resilience of the Cardiff demand group, noting it would still be technically compliant.
- The DNO level split required [redacted]
- A split at NGET level would significantly isolate future customer connection constraints from the DNO network.

[redacted]

**Site Optimisation**

Following the selection of the preferred solutions of option E-4 and DNO2, an additional stage of optioneering was undertaken to optimise the site layout. Five layouts were produced and the preferred layout 6E was selected.

This layout is the lowest cost, highest NPV option that retains futureproofing for additional future SGTs and building capacity. It has OHL realignment for four circuits; however, the 5th is cabled reflecting engineering challenges of aligning the fifth circuit within the available space. The layout and SLD are presented below.





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