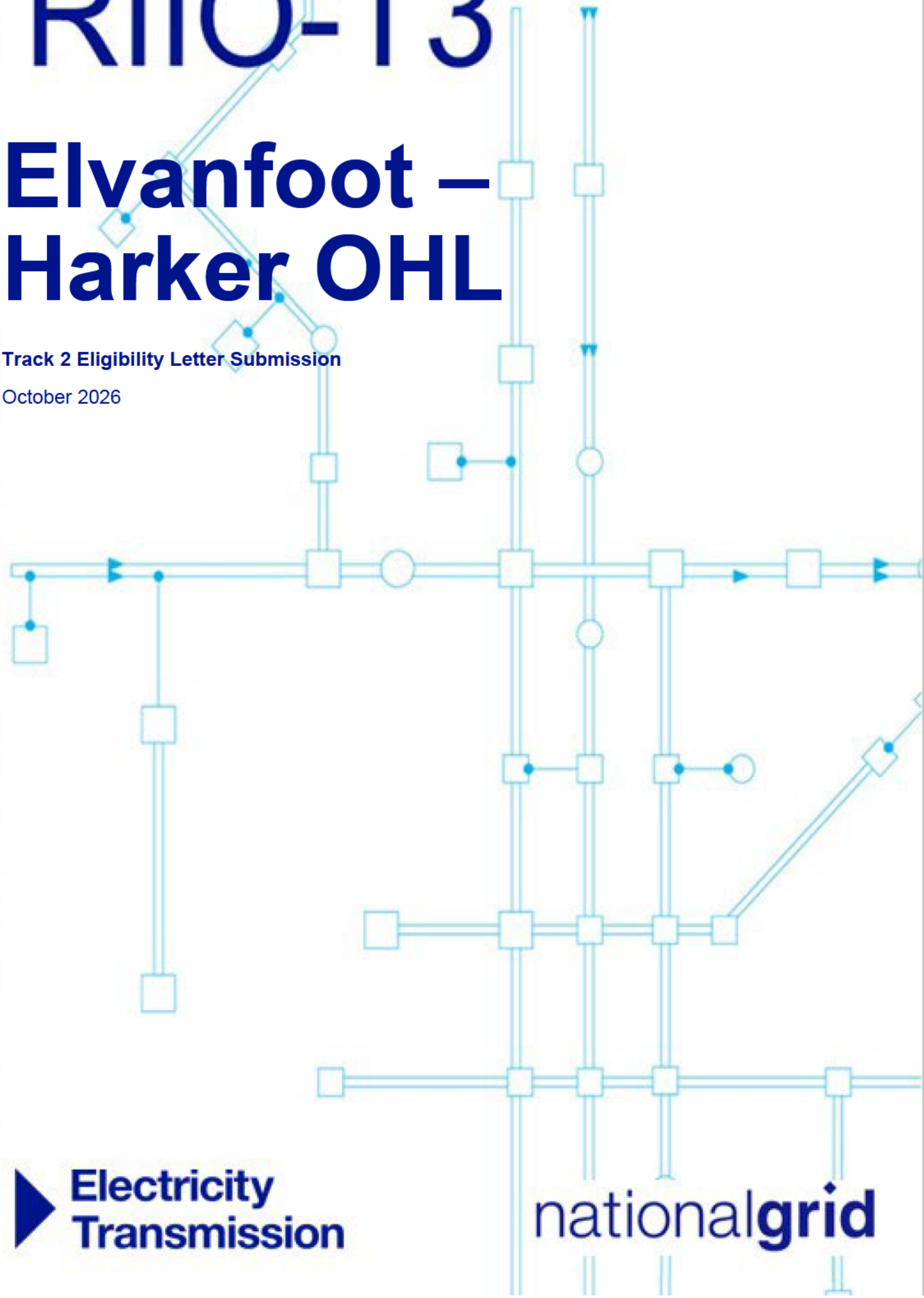
RIIO-T3

Elvanfoot – Harker OHL

Track 2 Eligibility Letter Submission

October 2026



Electricity Transmission

nationalgrid

Contents

Reference and summary table iii

Executive summary vi

1. Introduction 1

1.1 Elvanfoot (Gretna)–Harker and Harker–Moffat 400 kV overhead line reconductoring (EHRE) 1
Eligibility, Project Track Statement and PASE 1
Preconstruction funding request 2

1.2 Background 3
Chronology of investment 3
Regional and network context 4
Site background 7
Historical funding 8
Early Asset Write Offs (EAWO) 8

2. Drivers and need case 9

2.1 NESO 10

2.2 Asset health 11

3. Optioneering 13

3.1 Strategic options 13

3.2 Siting 14

3.3 Longlist of options considered 14
Stakeholder influence on shortlisting 19

3.4 Shortlisted options 20
Description of short-list options considered 20

3.5 Qualitative assessment of shortlist 23
Qualitative assessment output 24
PASE alignment 24

3.6 Quantitative analysis of shortlist options 25
Cost estimates of shortlist options 25
Cost Benefit Analysis (CBA) 26

3.7 Preferred solution 30
Project benefits and outputs 31

4. Delivery 32

4.1 Delivery year and indicative timeline 32

4.2 Procurement and contracting strategy 34

4.3 Risks and risk management 34

5. Conclusion 36

Appendix A Glossary A1

Appendix B System design table B1

Appendix C EHRE Layout Drawings C1

List of Figures

Figure 1: Summary of chronology 4
Figure 2: Proposed location of EHRE on our network 5
Figure 3: Network diagram of the surrounding area 6
Figure 4: Location of EHRE in relation to the B6 Boundary 11
Figure 5: Indicative programme of work for EHRE 33
Figure 6: Layout Drawing of option E-2 (reference: PDD-101268-LAY-002) C1
Figure 7: Layout Drawing of option E-3 (reference: PDD-101268-LAY-003 C2

List of tables

Table 1: Summary of options viii
Table 2: Estimated costs for pre-construction activities (£m 23/24 prices) 3
Table 3: Interactive projects 7
Table 4: Investment drivers 10
Table 5: EHRE Asset Health Summary Table (2025/26 Asset Health Review) 12
Table 6: Strategic direction setting 13
Table 7: Assessment of longlist options 15
Table 8: Multifactorial analysis 23
Table 9: Cost estimate breakdown 25
Table 10: Lifetime CBA (2023/24 prices, central carbon pricing, discounted values) 28
Table 11: Summary of all additional Capex costs (2023/24 base prices) 29
Table 12: Summary of all benefits 29
Table 13: Summary of outputs and benefits 31
Table 14: Summary of risks and mitigations 35
Table 15: Submission summary 37
Table 16: Table of abbreviations and definitions A1
Table 17: System design table B1

Reference and summary table

Field	Description
Project name	Elvanfoot (Gretna)-Harker and Harker-Moffat 400 kV Overhead Line Reconductoring (EHRE)
TO's preferred re-opener track	Eligibility Letter – Track 2
RRP reference	NGT500437
BPDT / Scheme reference number	NGT500437
Load Board Reference	This project has not been included on the agenda of any previous Load Board meetings.
Investment driver(s)	• **NESO:** Deliver [redacted] circuit capability and approximately [redacted] MW of additional B6 transfer capacity by 2030. • **Asset health:** [redacted] to reduce failure and outage risk.
Project outputs	• **Deliver the Harker interface works:** Divert the Gretna overhead-line circuit into the new 400 kV Gas Insulated Switchgear (GIS) substation through an extended Gas Insulated Busbar (GIB) connection, associated equipment, a line take-off gantry and three new towers, while retaining the existing [redacted] towers. • **Uprate the Moffat interface:** Utilise the existing 400kV cable run between the existing and new Harker substations, including modifications to the cable boxes, sealing ends and associated compound, civil, access, security and cable-route works. • **Supports delivery of the approved [redacted] circuit rating:** Increase the circuits' winter post-fault rating to [redacted], providing approximately [redacted] MW of additional B6 boundary capability and supporting increased north-to-south renewable power flows and peak network demand. • **Deliver coordinated asset-health benefits**: [redacted] longside the load-related reinforcement, avoiding future standalone interventions and reducing outage requirements, network disruption and costs to consumers.
Short list of strategic options considered	This paper's optioneering is limited to the incremental Harker cable and interface works identified through subsequent coordinated design development. It assesses

	the efficient means of resolving the Harker interface constraint and establishing the final integrated configuration of the EHRE and Harker infrastructure. As the underlying need, Overhead Line (OHL) optioneering and baseline-funded reconductoring solution were established through the RIIO-ET3 Engineering Justification Paper (EJP) these are not reopened in this submission. Two main options were shortlisted for detailed analysis: **Cable works** • Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces • Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection
Preferred solution and explanatory narrative on the rationale	**Option E-3: Divert the Gretna overhead line and uprate the Moffat cable connection.** Option E-3 is preferred because it removes the Harker interface constraint and enables the approved circuit uprating with future-proof capacity, while maximising the use of existing cable design, avoiding abortive cable works, reducing infrastructure and delivery risk, and providing the strongest consumer value at [redacted] million with a Net Present Value (NPV) of [redacted] million.
PASE alignment	Option E-3 is not PASE-aligned because its project-specific combination of overhead line, gas-insulated line and cable infrastructure is not a defined PASE primary or variant solution. Option E-3 is a proportionate departure from PASE because it provides a compatible, lower-cost interface with the Harker GIS and cable routing.
Cost (23/24 prices)	Total project costs for EHRE: [redacted] m (including 13.8% risk and contingency in 2023/24 price base). This is split: • [redacted] m for reconductoring works, of which we have already had baseline funding approved in the RIIO-ET3 Final Determinations (out of scope of this submission) • [redacted] for the Harker interface works (the scope of this submission) As discussed with Ofgem, we are submitting a reopener for this linked output to EHRE to ensure appropriate regulatory scrutiny
Delivery year	• Energisation and delivery of the network output: December 2029.

	— National Energy System Operator (NESO) network need date: 2030. — Final reinstatement, demobilisation and contract completion: January 2031.
Extension cost (applicable only to substations)	N/A
Applicable reporting tables	6.1 Scheme C&V Load Actuals, 6.5 T3 Baseline Load
Interactive projects	• **Harker 400kV substation**: Rebuild of Harker substation and rationalise to leave new 400kV and 132kV substations with six 400/132 kV 240MVA SGT's. • **CMN3**: New 400 kV overhead line from South East Scotland to North West England (near Carlisle). • **WCN2:** Additional cross-border 400 kV reinforcement connecting South West Scotland to Harker.
Historic funding interactions	The OHL reconductoring works for the EHRE project received £[redacted] in baseline funding as part of the RIIO-ET3 Final Determinations to replace the existing twin Rubus conductors with [redacted], together with associated fittings, Optical Ground Wire (OPGW), downleads and necessary tower, foundation and enabling works.
Spend apportionment (combined EHRE and this project)	**T2 (FY 2022-2026):** £[redacted] **T3 (FY 2027-2031):** [redacted] **T4+ (FY 2032- 2037+):** [redacted]

Executive summary

Project summary

To enable the previously approved Elvanfoot (Gretna)–Harker and Harker–Moffat 400 kV Overhead Line Reconductoring project (EHRE) circuit uprating to [redacted] winter post-fault, additional works are required at Harker because the detailed cable design identified localised rating constraints, preventing the output being met and the future proofing of the cable circuits.

The EHRE project received [redacted] million of RIIO-ET3 baseline funding for the Overhead Line (OHL) reconductoring scope; this submission therefore seeks approval only for the incremental Harker interface works required to realise that approved output.

The underlying need and baseline-funded OHL scope are not reassessed in this submission. The current design basis remains [redacted] however, the final conductor technology will be confirmed ahead of procurement and Project Assessment, taking account of type-registration status, technical suitability and coordination with Scottish Power Transmission.

Therefore, we do not revisit any of this optioneering within this submission, please refer to the Major Project Engineering Justification Paper (EJP), "Gretna – Harker – Moffatt OHL" submitted as part of National Grid Electricity Transmission's (NGET's) December 2024 Business Plan.

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 the incremental Harker cable and interface works required to enable delivery of the approved Elvanfoot (Gretna)–Harker and Harker–Moffat 400 kV overhead line reconductoring (referred to as EHRE herein after) project.

This submission proposes Eligibility Letter – Track 2 Load Re-Opener process for assessment. The track proposal has been discussed with Ofgem.

Project need

The RIIO-ET3 EJP established the need to increase north-to-south transfer capability across the B6 boundary and identified OHL reconductoring as the preferred EHRE solution. The investment will increase the winter post-fault rating of the Elvanfoot (Gretna)–Harker and Harker–Moffat circuits from approximately [redacted], providing around 400 MW of additional B6 boundary capability and supporting National Electricity Transmission System (NETS) Security and Quality of Supply Standard (SQSS) compliance. EHRE's role within the wider coordinated Anglo-Scottish reinforcement programme is described in Section 1.2 Background.

Subsequent development identified that the existing Harker cable arrangement cannot accommodate this uprating, creating an additional constraint that must be addressed to realise the approved EHRE output. The incremental Harker works form part of the final infrastructure solution required to achieve the total approved EHRE outcome. The baseline-funded overhead-

[redacted]

line reconductoring and the Harker interface must operate as an integrated system: without the interface works, the Harker cable arrangement would remain the limiting component and the approved [redacted] MVA winter post-fault rating could not be realised.

This submission therefore assesses only the incremental cable and interface works required to remove that constraint and does not reopen the approved need or baseline-funded OHL solution.

As the EHRE and Harker projects subsequently progressed in parallel, detailed technical assurance of the combined interface identified that the planned Harker cable arrangement would constrain the uprated circuits. NGET therefore initiated targeted optioneering and is presenting the issue through this Eligibility Letter – Track 2 assessment once the requirement, credible alternatives and preferred solution had been developed sufficiently to support informed regulatory scrutiny.

The assessment has focused on protecting consumers by integrating the required changes with the Harker programme, making efficient use of cables already procured for the Moffat connection and selecting the lowest-cost technically compliant option.

This submission separates the £[redacted] million baseline-funded OHL scope from the incremental Harker interface works for which approval is now sought.

Optioneering to date

The underlying need and baseline-funded OHL solution remain unchanged; this section summarises the optioneering to date for the incremental Harker interface assessment supporting this Eligibility Letter – Track 2 submission.

Eight strategic options were assessed for the Harker interface. We ruled out non-build options because they would not meet the need. We selected Option E-3, which diverts the Gretna circuit into the new Harker Gas Insulated Switchgear (GIS) through an OHL-to- Gas Insulated Busbar (GIB) interface and retains the Moffat connection as a cable interface, adding a third cable run per phase to achieve the required rating. E-3 was preferred to E-2 following programme, cost and abortive-work assessment. Table 1 sets out the optioneering summary.

The selected design comprises 400kV Gretna with OHL and GIB, Moffat with Cable extension (Option E-3), which together form the preferred solution supported by the optioneering assessment and the layouts in Section 3 Optioneering.

Table 1: Summary of options

Option	Details	Drivers met?	New site?	Shortlist?	Preferred solution?
Option A	Do nothing counterfactual option	No	N/A	No	No
Option B	Market-based solution	No	N/A	No	No
Option C	Non-transmission, whole systems solution	No	N/A	No	No
Option D	Re-use of Existing Cable design (2 cores per phase)	No	N/A	No	No
Option E-1	Extend GIB from the new Harker GIS substation to the existing Gretna and Moffat gantries.	Yes	N/A	No	No
Option E-2	Divert the Gretna and Moffat overhead lines to the new Harker GIS substation	Yes	N/A	Yes	No
Option E-3	Divert the Gretna overhead line and uprate the Moffat cable connection	Yes	N/A	Yes	Yes
Option E-4	Connect Gretna and Moffat through new GIB and cable links to the existing gantries	Yes	N/A	No	No

Cost estimates

Based on the latest Cost Book (2023/24 prices) and early project estimates, the estimated total cost to deliver EHRE (which includes the cost of the Twin Matthew GAP reconductoring, and the associated Harker cable works, Option E-3 in this submission) is £26.4m including risk and contingency of 13.8%. [redacted] estimated project cost is split:

- [redacted] for the Harker interface cable works (the scope of this submission)

This submission seeks an incremental allowance, to be finalised through the Project Assessment, for the Harker cable and interface works, currently estimated at £[redacted] including risk and contingency.

Although this incremental scope is below the £40m Load UIOLI threshold, it forms part of the wider EHRE project alongside the £[redacted] baseline-funded OHL scope. We therefore consider it appropriate to seek funding through the Load Related Re-opener, as treating the incremental

works separately under Use-it or Lose-it (UIOLI) could be regarded as splitting a larger project to remain within the Use-it or Lose-it UIOLI threshold and avoid Load Re-opener scrutiny. We have tested this interpretation with Ofgem.

We are not requesting any further allowance for the reconductoring works, approved in our T3 baseline funding of [redacted]

Indicative delivery programme

EHRE is scheduled to be energised by December 2029, ahead of the NESO-signalled 2030 network need date. Final reinstatement, demobilisation and contract completion will continue following energisation and are planned to conclude by January 2031.

Delivery will progress through development, consenting, design, procurement, construction and commissioning, coordinated with Scottish Power Transmission, the Harker Energy Enablement programme and approved outages, and remains dependent on timely land access, consents, long-lead equipment, supply-chain capacity and alignment with adjacent works.

1. Introduction

1.1 Elvanfoot (Gretna)–Harker and Harker–Moffat 400 kV overhead line reconductoring (EHRE)

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 EHRE.

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)
- confirmed acceptance of Option E-3 as the preferred Gretna and Moffat interface solution at Harker.
- confirmation that the project should proceed via Eligibility Letter – Track 2 of the re-opener process; and
- approval of Pre Construction Funding (PCF) under Special Condition 3.15 (Pre Construction Funding Reopener, Price Control Deliverable).

The approved EHRE need, Overhead Line (OHL) output and selection of Twin Matthew are set out in the RIIO-ET3 Major Project Engineering Justification Paper (EJP) and are not repeated here except where necessary to explain the cable-interface requirement.

Option E-3, divert the Gretna overhead line and uprate the Moffat cable connection, is preferred because it provides a technically compliant and deliverable solution while enabling the Moffat cable works to proceed with the Harker-Gretna circuit remaining in circuit, reducing outage and programme risk.

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 OHL reconductoring scope has received RIIO-ET3 baseline funding; however, this submission relates only to the additional Harker cable and interface works identified after the EJP was prepared. No costs already funded through the baseline award are included in the allowance requested through this submission.

This submission proposes the Eligibility Letter (EL) – Track 2 of the Load Re-Opener process for assessment. The track proposal has been discussed with Ofgem.

Assessment Track 2 is appropriate for the following reasons:

- **The underlying need is established.** EHRE was included in National Grid Electricity Transmission's (NGET's) RIIO-ET3 Business Plan, received £18.4 million of baseline funding for the OHL uprating and is supported by National Energy System Operator (NESO) planning signals. This submission does not reopen the strategic need or the baseline-funded OHL solution.

- The incremental scope is defined and necessary. Subsequent technical assurance identified that the detailed cable design, would constrain the uprated circuits. The proposed works address that interface constraint and enable delivery of the approved EHRE output; they do not introduce a separate investment objective.
- **The non-PASE departure is limited.** The underlying intervention retains and uprates the existing transmission corridor, limiting new infrastructure, land take and disruption. However, the complete OHL, Gas Insulated Busbar (GIB) and cable configuration is not a defined Pre-Approval of Solution Engineering (PASE) Primary or Variant solution and is therefore treated as non-PASE-aligned.
- **The preferred solution has been selected through proportionate optioneering.** Four Harker interface arrangements were assessed, with E-2 and E-3 progressed for detailed comparison. Option E-3 was subsequently selected because it integrates the final Moffat cable arrangement with the Harker delivery programme, avoiding abortive cable works and reducing system access requirements.
- **Further Needs Case Assessment would not add material value.** The preferred option is identified; the credible alternatives have been assessed and the reason for departing from PASE is limited to the Harker interface. Subject to the project remaining below the £300 million Track 2 threshold, the justification is sufficiently clear and uncomplicated to support progression directly to Project Assessment.

This project is not 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 8.2% of its total forecasted cost (£[redacted] at the time of this Load Re-Opener Eligibility Letter submission).

Based on our current forecast we have provided below breakdown of costs amounting to £[redacted] as part of this submission. This equates to 8.2% of the latest total forecast project costs.

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. 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.

[redacted]

1.2 Background

Chronology of investment

NESO's July 2022 Network Options Assessment (NOA) Refresh identified EHRE as a Holistic Network Design (HND) Essential reinforcement required to provide an additional 400 MW of B6 boundary capacity by 2030. Following feasibility and optioneering, NGET selected reconductoring [redacted] of its double-circuit overhead line, coordinated with Scottish Power Transmission's (SPT's) adjoining [redacted], as the preferred solution. NESO reaffirmed the need through Beyond 2030, and NGET submitted the project through its December 2024 RIIO-ET3 Business Plan EJP, securing baseline funding for the OHL scope.

Following submission of the December 2024 EJP, the EHRE reconductoring design and Harker Energy Enablement project continued to develop in parallel. Coordinated technical assurance subsequently identified that the planned Harker cable arrangement would constrain the approved EHRE uprating. NGET therefore initiated targeted optioneering to identify the minimum efficient corrective solution. Further technical assessment and coordination with SPT refined the scope, outage sequencing and Harker interface arrangements, taking account of constructability, consenting, land, programme and asset-replacement dependencies.

This work established the preferred solution and supporting evidence for the updated optioneering and Eligibility Letter – Track 2 planned for submission under the Load Re-opener in October 2026, targeting delivery of the required capacity uplift by 2030.

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

Figure 1: Summary of chronology



Regional and network context

Transmission Network

Lancashire and Cumbria contain [redacted] 400 kV infrastructure forming the North West transmission interface between Scotland, northern England and [redacted] demand centres further south. The network is primarily configured to transfer power from Scotland through England, while also supporting [redacted] offshore wind and [redacted] domestic and industrial demand around Lancashire and Merseyside. The Harker–Penwortham network currently constrains north-to-south transfer capability, making reinforcement of the Anglo-Scottish and North West corridors essential as renewable generation and associated power flows increase.

Strategic Energy Initiatives

Scotland's rapid growth in renewable generation, particularly offshore wind, is expected to substantially increase north-to-south power transfers. EHRE is scheduled to deliver the required network capability by December 2029, ahead of the NESO-signalled 2030 need date. This supports the Pathway to 2030 and the UK's wider net-zero and energy-security ambitions by increasing transfer capacity across the B6 boundary and enabling Scottish renewable generation to reach demand centres in England. Alongside continued [redacted] ffshore wind, storage, electrification and industrial transition will further reinforce the strategic importance of Lancashire and Cumbria as both a generation region and national transfer corridor.

NGET's Network Strategy: RIIO-T3 to 2031 and Beyond

EHRE forms part of NGET's wider North West enhancement programme and will uprate the Elvanfoot (Gretna)–Harker and Harker–Moffat circuits in response to the need identified through the NOA7 Refresh. The project interfaces with the Harker Energy Enablement project supporting the transfer of increased Scottish generation into England. During RIIO-T3, NGET's strategy includes 400 kV circuit reconductoring, targeted substation upgrades and development of new network nodes, including Carlisle, to relieve thermal constraints, improve resilience and strengthen north-to-south transfer capability. Beyond 2031, further phased investment may be required as renewable generation, nuclear development and major new demand evolve.

EHRE contributes to the wider B6 boundary reinforcement strategy and supports the delivery of HND Essential and transitional Centralised Strategic Network Plan (tCSNP) requirements. This demonstrates the role of EHRE in enabling renewable generation integration, maximising the value of wider transmission investment and supporting a coordinated network development approach. EHRE addresses a critical transfer bottleneck on the network, rather than simply providing an uplift in conductor capacity.

[redacted]



Interactive projects

The EHRE project covers the OHL between two substations, Elvanfoot and Harker. At Harker, there is a significant extension and new site planned for asset health, customer connections and uprating purposes at the site.

NGET will need to ensure all projects are completed sequentially in line with the NOA and tCSNP recommendations and customer connection dates to fully unlock the B6 boundary constraints. Significant supply chain and outage requirements will also need to be managed to ensure a deliverable solution.

Table 3: Interactive projects

Project	Details	Status
Harker 400kV Substation	Rebuild of Harker substation and rationalise to leave a new 400kV and 132kV substations with six 400/132 kV 240MVA Super Grid Transformers (SGT's)	[redacted]
CMN3	400 kV reinforcement from south-east Scotland to north-west England, providing additional B6 boundary capability. Its interaction with EHRE is principally through the shared network need, with no direct physical interface.	Proceed (Maintain) following the tCSNP2 Refresh
WCN2	Later cross-border 400 kV reinforcement from south-west Scotland to Harker, providing additional B6 boundary capability. WCN2 assumes EHRE is complete before its works commence and will require coordination at the refurbished Harker 400 kV substation	Proceed (Maintain) following the TCSNP2 Refresh

Site background

The baseline-funded OHL works remain within the existing route and are described in the RIIO-ET3 EJP.

Harker comprises an existing 400 kV double-busbar Air Insulated Switchgear (AIS) substation and a replacement 400 kV Gas Insulated Switchgear (GIS) development under construction immediately to its north through the Harker Energy Enablement project. The Gretna and Moffat circuits currently connect to the existing substation through OHL gantries and were planned to transfer into dedicated bays in the new GIS using cable connections between the two sites.

Historical funding

EHRE received [redacted] million of RIIO-ET3 baseline funding for the OHL reconductoring scope described in the Major Project EJP.

This submission excludes that approved scope and seeks funding only for the incremental Harker cable and interface works identified through subsequent project development.

Early Asset Write Offs (EAWO)

No early asset write-off is expected for the incremental EHRE interface works under the planned delivery programme.

2. Drivers and need case

As set out in the RIIO-ET3 EJP, EHRE is required to increase north-to-south transfer capability across the B6 boundary by approximately [redacted] MW by uprating the Elvanfoot (Gretna)–Harker and Harker–Moffat circuits from a winter post-fault rating of approximately [redacted]. Ofgem has already approved this underlying need and the baseline-funded OHL reconductoring solution, which are not reassessed in this submission.

The preferred solution is therefore not a separate capability enhancement. It is the minimum additional infrastructure required at Harker to realise the total approved EHRE outcome.

The preferred solution must support delivery of the approved [redacted] winter post-fault rating. Detailed development identified that the planned two-run-per-phase Harker cable arrangement, rated at approximately [redacted] would constrain the uprated circuits. Retaining that arrangement would therefore leave a foreseeable interface limitation and could require a further intervention before the approved outcome could be realised. Option E-3 provides the minimum efficient solution by integrating the final Moffat cable arrangement with the planned Harker works, reducing additional construction, system access, outages and consumer cost.

The Available for Commercial Load (ACL) dates presented in this submission reflect the P6 programme.

The investment drivers for the EHRE project as a whole, are included in Table 4 below.

Table 4: Investment drivers

Summary of drivers		ACL date
NESO (Primary driver)	• EHRE will reconductor the Elvanfoot–Harker circuits to add approximately [redacted] MW of B6 boundary capability, supporting north-to-south renewable power flows. • Studies identified a minimum winter post-fault conductor rating of [redacted], with detailed optioneering undertaken after the initial NESO signal. • The project is designated HND Essential and is scheduled to be energised by December 2029, ahead of the NESO-signalled 2030 network need date, supporting forecast B6 transfer requirements of almost [redacted] GW by 2030 and [redacted] GW by 2035.	2029
Asset Health (secondary driver)	• We must replace [redacted] forecast to reach [redacted] the end of RIIO-T3. This is an asset-health driver, evidenced by condition assessments and asset management forecasts. Without intervention, asset failure risk would increase, potentially leading to unplanned outages and reduced network reliability.	2029

2.1 NESO

NESO has identified a strategic requirement to increase transfer capability across the B6 boundary, which forms the interface between the Scottish and English transmission networks and enables renewable generation in Scotland and northern England to reach demand centres further south. The B6 boundary crosses two 400kV double-circuits and two 132kV single-circuits. The Western High Voltage Direct Current (HVDC) Link also crosses this boundary.

Boundary B6 separates the transmission network at the Scottish Power Transmission and NGET interface running roughly along the border between Scotland and England, which is illustrated in Figure 4 below.



NESO forecasts indicate that B6 transfer requirements will increase to [redacted] In response, NGET's boundary capability studies identified EHRE as the minimum reinforcement required to address thermal constraints on the Elvanfoot (Gretna)–Harker and Harker–Moffat circuits. Reconductoring will increase the circuits' winter post-fault rating from approximately [redacted] providing around [redacted] MW of additional B6 capability and supporting NETS SQSS compliance.

NESO designated EHRE as an HND Essential project in the NOA7 Refresh, with a 2030 network need date, and subsequently confirmed the reinforcement need through Beyond 2030. NGET is targeting energisation by December 2029 to deliver the required capability ahead of that date. Following NESO's investment signal, NGET assessed the wider network drivers and available options, concluding that reconductoring makes efficient use of the existing corridor and provides the required capacity within the necessary timeframe.

2.2 Asset health

The primary focus of the EHRE investment is to increase network capacity. Asset health considerations provide an additional benefit and efficiency opportunity but are not a key driver for the investment.

A summary of the current asset health position is provided in Table 5, which reflects our latest, assured 2025/2026 asset condition data. Current asset health assessments place all EHRE assets below intervention thresholds.

[redacted]

Although there are some [redacted] present on this route as shown in Table 5, at the time of construction of the T3 non-load plan, [redacted] As a portfolio, this is programmed to be addressed by the end of the T4 period[4]. Therefore, no asset health driven interventions are included in the non-load plan for this route and no asset health funding is sought separately.

While asset health is not the primary investment driver for this reconductoring scheme, [redacted] y completing these replacement activities as part of the load-related reinforcement, the project avoids future standalone asset-health interventions, reduces future outage requirements and minimises disruption to network users. This coordinated approach provides additional consumer value by combining load-related and asset-management activities within a single outage and construction programme.

[2] 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.

[3] 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.

[4] As discussed in NGET_RIIO3_NGETQ10_OHL F&C Appendix A - Ofgem-NGET DD Eng Bilateral - 30 July 2025

3. Optioneering

The RIIO-ET3 EJP assessed the strategic means of meeting the EHRE need and established [redacted] as the baseline-funded OHL design basis. This submission does not reopen the strategic OHL optioneering, as its assessment is limited to the incremental Harker cable and interface works. The final conductor technology will nevertheless be assessed ahead of procurement and Project Assessment, taking account of type-registration status, technical suitability and coordination with Scottish Power Transmission.

The optioneering below therefore considers only the technically feasible means of connecting the uprated circuits into the Harker arrangements and removing the newly identified cable limitation.

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: Engineering, environmental, deliverability, economic/consumer value and consenting/stakeholder.
4. We then assess quantitatively all shortlisted options in a CBA to determine which technical option provides greater Net Present Value.
5. We then consider the outputs of both step 3 and 4 to provide a final preferred option.

Siting studies inform decisions on whether options should be rejected or progressed. Although this document presents the process sequentially, siting work is often undertaken in parallel with the assessment of longlisted and shortlisted options.

3.1 Strategic options

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

Table 6: Strategic direction setting

Option	Description
Option A: Do nothing	The network is kept in its current state, and no new connections are facilitated.
Option B: Market based solution	Increased customer demand is accommodated through the procurement and use of ancillary services only.

Option	Description
Option C: Whole systems solution	The requirement is met through a coordinated whole-system solution combining transmission and distribution interventions.
Option D: Make use of existing assets	Facilitating the requested connection by utilising the existing assets
Option E: New build	Facilitating the requested connection by new asset infrastructure

We discounted Options A, B, C and D due to the inability of these options to facilitate the connection requests and therefore fulfil our licence obligation, Transmission Licence (Licence Condition C8).

A descriptive rationale for rejection or progression from the longlist is explained in Table 7.

3.2 Siting

A standalone siting study was not undertaken for the incremental EHRE works because their location is fixed by the need to connect the existing Gretna and Moffat circuits to the new Harker 400 kV GIS substation and uprate the constrained interface between the existing and new substations.

The works must therefore be delivered within the existing Harker site and immediate transmission corridor, where the relevant circuits and infrastructure are located. As no credible alternative site would remove the interface constraint or avoid the investment, a separate siting study would not have identified a materially different or lower-cost solution and was not considered proportionate for consumers.

Instead, the optioneering assessed alternative cable, GIB and OHL interface arrangements within and immediately adjacent to the Harker site, taking account of space, land, consenting and constructability constraints. [redacted]

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 7: Assessment of longlist options

Option name and status (progressed/not progressed)	Technical Description	Relevant diagrams, layout or Single Line Diagram (SLD) reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
		Incremental Cable Works		
Option A: Do nothing **Rejected**	The network is kept in its current state, and EHRE circuits are not uprated	N/A	N/A	• **Engineering:** Rejected as retaining the existing arrangements would leave the Harker interface constrained and prevent delivery of the approved EHRE output. The option would not achieve the required [redacted] circuit rating or the associated increase in B6 boundary capability. • **Compliance:** Would not comply with SQSS.
Option B: Market based solution **Rejected**	Increased customer demand is accommodated through the procurement and use of ancillary services only.	N/A	N/A	• **Engineering**: Rejected as the option would rely on ongoing constraint management and balancing actions to accommodate increased transfers. It would not provide the required permanent increase in transmission capacity or address the underlying network limitation. The option therefore does not provide an enduring solution to the identified need.
Option C: Non-transmission, whole systems solution **Rejected**	The required capacity increase is explored via non transmission or whole system alternatives in pace of dedicated Cable works	N/A	N/A	• **Engineering**: Rejected as no viable non-transmission or whole-system alternative was identified that could provide the required increase in transmission transfer capability. The need is driven by a transmission boundary limitation, and the distribution network cannot deliver the required increase in boundary capability. Reinforcement is

Option name and status (progressed/not progressed)	Technical Description	Relevant diagrams, layout or Single Line Diagram (SLD) reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
				therefore required to provide the enduring network capacity increase.
Option D: Reuse of existing cable design (2 cores per phase) **Rejected**		N/A	N/A	• **Engineering**: Detailed design of the Harker Energy Enablement cable arrangement confirmed that th [redacted] ating due to thermal limitations associated with cable crossings and route constraints, restricting achievable capacity. Modelling indicated that the current design reaches within [redacted] thermal limits at existing OHL ratings. This would not meet the requirements of the additional boundary uplift or future proofing to align with the proposed conductor system. Potential mitigations such as ventilated troughs (which could meet the required rating) were not feasible due to limited site space and the public road crossing, which would present security concerns due to potential access to the cables through the ventilation points. The option was therefore discounted.
Option E-1: Extend GIB from the new Harker GIS substation to the existing Gretna and Moffat gantries. **Rejected**	Retains both existing OHL gantries and connects each circuit using approximately [redacted] of GIB per phase, with no new towers or power cables.	PDD-101268-LAY-001	The approximately [redacted] m GIB route per phase and circuit would cross one public road and four internal substation roads, requiring high-level structures, public-road approval and road closures during installation and maintenance. The route would also pass between separate secure compounds, creating a potential security concern, and would require careful routing to avoid SGT fire-damage zones, buried services,	• **Engineering**: Meets the required rating using proven GIB technology, but faces access, equipment and buried-service constraints at the existing gantries. • **Environmental**: Non-SF_6 technology reduces carbon impact, although the long GIB route increases gas-leakage exposure. • **Deliverability**: Offline construction is possible, but road crossings, supplier lead

Option name and status (progressed/not progressed)	Technical Description	Relevant diagrams, layout or Single Line Diagram (SLD) reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
			cable troughs and other infrastructure. Although the proposed GIB uses non-SF_6 technology, its length increases the risk of insulating-gas leakage and associated environmental effects.	times, access constraints and enabling works create significant programme risk. • **Outcome**: Rejected because its cost, routing complexity and delivery and consenting risks outweighed its technical benefits.
Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces **Progressed**	Diverts both circuits over approximately [redacted] of OHL using three new towers, two gantries and approximately [redacted] of GIB per phase per circuit.	PDD-101268-LAY-002	The short OHL diversion avoids impacts on woodland nature reserves, retains Harker Moss and avoids crossing the new Gretna–Hawick 132 kV OHL. New towers and gantries require Section 37 consent, planning approval and updated wayleaves. [redacted] The substation compound would also require extension, earthworks, security infrastructure, access roads and foundations.	• **Engineering**: Provides a compliant OHL and GIB interface for both circuits, avoids constrained cable installation and supports future uprating. • **Environmental**: The limited OHL diversion minimises environmental and landowner impacts, retains Harker Moss and avoids woodland nature reserves. • **Deliverability**: Enables substantial offline construction without simultaneous circuit outages, although temporary diversion and outage sequencing are required.
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection **Progressed**	Diverts Gretna over approximately [redacted] of OHL with three towers and [redacted] of GIB per phase, while adding a third Moffat cable run per phase.	PDD-101268-LAY-003	The short Gretna OHL diversion avoids woodland nature reserves, retains Harker Moss and avoids crossing the new Gretna–Hawick 132 kV OHL. New towers and the gantry require Section 37 consent, planning approval and updated wayleaves, and [redacted] The additional Moffat cable run has a substantial space requirement and may require diversion of	• **Engineering**: Provides a compliant OHL and GIB interface for Gretna, uprates the Moffat cable connection and retains existing OHL infrastructure. • **Engineering:** Option E-3 enables cables procured through the Harker Energy Enablement project to be used within the final Moffat connection. Under Option E-2, [redacted] procured cable lengths would not be required and could result in avoidable

Option name and status (progressed/not progressed)	Technical Description	Relevant diagrams, layout or Single Line Diagram (SLD) reference	Consenting risk and environmental constraints	Rationale for rejecting or taking forward the option
			underground services or negotiation of buried obstacles within the existing substation.	consumer costs if they cannot be cancelled, reused or reallocated. • **Environmental**: The limited Gretna diversion minimises environmental and landowner impacts, retains Harker Moss and avoids woodland nature reserves. • **Deliverability**: Enables the Moffat cable works to proceed while the Harker–Gretna circuit remains in service, although cable interactions, diversions and outage sequencing add complexity.
Option E-4: Connect Gretna and Moffat through new GIB and cable links to the existing gantries **Rejected**	Retains both existing OHL gantries and connects each circuit through GIB–cable–GIB arrangements, requiring three cable runs per phase and [redacted] single-core cables overall	PDD-101268-LAY-004	The route is severely constrained within the Harker site. Accommodating [redacted] cables within the available corridor would create a substantial space take, likely require underground-service diversions and additional installation measures, and require careful coordination of GIB supports with existing cables, troughs and buried services. The GIB would also require a high-level crossing of an internal substation road. The proposed GIB is non-SF_6, providing a reduced-carbon benefit relative to conventional technology.	• **Engineering**: Meets the uprating requirement using proven GIB and cable technologies, but requires [redacted] cables within a constrained route, additional thermal-mitigation measures and complex interfaces with existing infrastructure. • **Environmental**: Non-SF_6 GIB reduces carbon impact, with no specific external environmental constraint identified. • **Deliverability**: Allows substantial offline construction, but enabling diversions, demolition works, supplier availability and outage sequencing create significant programme risk. • **Outcome**: Rejected because cable-route congestion, delivery dependencies, operational complexity and higher cost offered poorer consumer value than Options E-2 and E-3.

Our shortlisting rationale was:

- We ruled out Options A, B and C on technical grounds because they would not provide the compliant physical connections required to deliver the approved circuit uprating.
- We ruled out Option D on engineering and deliverability grounds because the existing two-run-per-phase cable arrangement could not achieve the required rating without substantial additional cable and interface works, increasing technical complexity and programme risk.
- We ruled out Option E-1 on spatial, access and deliverability grounds because its extensive gas-insulated connections would introduce significant constructability constraints, including interactions with roads, secure compounds and existing substation infrastructure. E-1 would require approximately [redacted] metres of gas-insulated connection per phase and circuit.
- We ruled out Option E-4 on spatial and constructability grounds because its extensive gas-insulated and cable requirements could not be accommodated efficiently within the constrained Harker site and would introduce disproportionate access and programme risks.

We shortlisted two technically compliant and deliverable options:

- E-2: Divert both the Gretna and Moffat overhead-line circuits into the new Harker GIS substation through OHL-to-GIB interfaces.
- E-3: Divert the Gretna circuit into the new Harker GIS through an OHL-to-GIB interface and retain the Moffat connection as a cable interface, adding a third cable run per phase.

Both shortlisted options enable substantial offline construction and avoid simultaneous outages of the Gretna and Moffat circuits. Option E-3 also provides greater flexibility to sequence the Moffat cable works with the Harker delivery and outage programme.

Stakeholder influence on shortlisting

Planning and consenting

The preferred interface requires three new towers, a cable sealing-end compound and underground cable works. The new towers require Section 37 consent; the cable sealing-end compound requires full planning permission; and the underground cables can proceed through permitted development rights only if the scheme is not screened as EIA development. A formal EIA screening opinion is therefore required. These requirements favour options that minimise new infrastructure and limit the extent of additional consenting.

Land requirements

Option E-3 requires three new towers, [redacted], this is being progressed through the project's established land and consents strategy. [redacted]

Constrained alignment

The proposed OHL alignment has been developed to avoid existing NGET cables and Static Synchronous Compensator (Statcom) infrastructure, minimise interaction with the proposed [redacted] MW [redacted] developments and avoid oversailing equipment that could present fire risk. This constrained context limits the availability of materially different alignments.

Environmental and planning commitments

The design must align with the approved Harker Energy Enablement landscaping scheme, associated Biodiversity Net Gain (BNG) commitments and a forthcoming Section 73 application. The strategy also identifies nearby nature reserves and protected designations as constraints on available land around the existing and new substations.

Interaction with other projects

Both shortlisted options, E-2 and E-3, require coordination with the Harker Energy Enablement project and SPT's reinforcement programme, particularly in relation to circuit transfers, outages and construction interfaces. Option E-3 provides closer alignment with the planned Harker works by incorporating the final Moffat cable arrangement into the delivery sequence, thereby reducing rework and additional system access. Continued coordination is required in relation to the proposed Section 73 amendment, Statcom installation, demolition of the existing Harker substation, the [redacted] MW [redacted] and SPT's associated works.

3.4 Shortlisted options

- **Option E-2:** Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces
- **Option E-3:** Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection

Description of short-list options considered

The existing Harker Energy Enablement design comprised two cable runs per phase for each of the Gretna and Moffat circuits, providing an interface rating of approximately [redacted] MVA. This is below the approved EHRE requirement of [redacted] winter post-fault. The shortlisted options therefore assess alternative means of uprating both interfaces: Option E-2 replaces the planned cable interfaces with OHL and GIB connections for both circuits, while Option E-3 adopts an OHL and GIB connection for Gretna and increases the Moffat cable arrangement to three runs per phase.

Option E-2: Divert the Gretna and Moffat overhead lines to the new Harker GIS substation

Proposed works:

- Divert the existing Gretna and Moffat overhead-line circuits from the existing Harker substation into the new 400 kV GIS substation.

- Extend the GIB connections northwards from the new GIS building and install associated bay equipment, line take-off gantries and AIS equipment.
- Construct three new OHL towers and two gantries and dismantle the existing [redacted] tower.
- Extend the substation compound, including associated earthworks, foundations, access, security and cable-trough infrastructure.

How it meets the driver:

- Provides uprated OHL and GIB connections for both circuits, enabling the Harker interface to meet the required circuit rating and avoiding complex cable installation within the space-constrained existing substation.

Drawings:

- Please see Appendix C for the SLD and layout drawings.

Option E-3: Divert the Gretna overhead line and uprate the Moffat cable connection

Proposed works:

- Divert the Gretna overhead-line circuit from the existing Harker substation into the new 400 kV GIS substation.
- Extend the Gretna GIB connection northwards from the GIS building and install associated bay equipment, a line take-off gantry and AIS equipment.
- Construct three new OHL towers while retaining the existing [redacted] line towers.
- Install a third Moffat cable run per phase between the existing and new Harker substations, together with the additional cable box, sealing ends and associated equipment. The latest programme schedules the Moffat cable construction between [redacted] with commissioning through the Stage 3 Moffat outage in [redacted] Incorporating the uprated arrangement within this planned Harker cable package enables the final [redacted] configuration to be delivered once, avoiding construction of the original lower-rated arrangement followed by subsequent modification or replacement.
- Extend the GIS compound and provide the required earthworks, foundations, access, security and cable-route infrastructure.

How it meets the driver:

- Uprates both circuit interfaces to the required rating by connecting Gretna through OHL and GIB and reinforcing the Moffat cable connection, while retaining existing OHL infrastructure and allowing the Moffat cable works to proceed with the Harker–Gretna circuit remaining in service.

Drawings:

- Please see Appendix C for the SLD and layout drawings

The System Design Table (SDT) for each option is provided within Appendix B. The technical parameters and scope presented in the System Design Table have been coordinated with the Scottish Transmission Owner (TO) for its respective elements of EHRE, supporting a consistent technical basis and aligned scope across the shared project interface.

In appraising these 2 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 8.

3.5 Qualitative assessment of shortlist

Table 8: Multifactorial analysis

Option	Optioneering categories				
	Engineering	Environmental	Deliverability	Economic / consumer value	Consenting / stakeholder
Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces	✓ Uses a standard OHL and GIB design compliant with National Grid technical procedures. ✓ Provides an established interface for both circuits, avoids complex cable installation within the constrained existing substation and allows future uprating. × [redacted] x OHL circuits increase risk of clearance infringements on the Statcom and 132kV tower, in a tight layout	× Proximity to the Harker Moss Nature Reserve. Usage of existing [redacted] tower under temporary condition.	✓ Major sections of the new OHL and GIB can be constructed offline, without simultaneous outages of the Gretna and Moffat circuits or a temporary mast. × However, the solution requires a temporary OHL diversion, phased outage sequencing and temporary [redacted] × OHL temporary diversion and outage sequence requires more system access than option E-3.	✓ Potential for further cost optimisation during subsequent design stages × Option E-3 uses cables procured through the Harker Energy Enablement project, whereas Option E-2 would leave 12 cable lengths surplus and could result in avoidable consumer costs if they cannot be reused or reallocated × Would require changes to the planned Harker cable scope and leave procured cable lengths surplus, increasing delivery complexity and potential consumer cost.	× New towers and gantries require Section 37 consent, planning approvals and updated wayleaves. × The temporary OHL diversion crosses [redacted] where there are presently unknown obstacles, creating third-party land and consent risk.
	Neutral	Detractor	Detractor	Benefit	Detractor
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection	✓ Uses a standard, compliant OHL and GIB interface for Gretna while retaining the existing Moffat OHL route and uprating its cable connection. ✓ It retains all existing ZV towers and provides potential flexibility for future circuit diversion. × The Moffat cable route crosses the substation and interfaces with existing filter circuits and [redacted] increasing layout and maintenance complexity.	✓ The short Gretna OHL diversion avoids woodland nature reserves, retains Harker Moss and avoids crossing the new Gretna–Hawick 132 kV OHL. The limited diversion minimises environmental and landowner effects and uses a standard OHL design with a known carbon footprint.	✓ The Moffat cable works can be constructed while the Harker–Gretna circuit remains in service, and the two circuits do not require simultaneous outages. ✓ Aligns with the 2027 Harker programme, delivering the final cable arrangement once and reducing additional construction and outages × However, uprating depends on prior [redacted] outages and cable diversions, together with coordinated OHL diversion and outage sequencing	✓ Provides a more flexible delivery strategy and reduces likelihood of delays to Gretna- Moffat uprating, reduces future constraint costs ✓ This is attributed to the ability to maintain one circuit in service during stage-by-stage construction with reduced outages ✓ Integrates the final three-run-per-phase Moffat arrangement into the planned Harker works, avoiding changes to the cable scope and reducing additional construction and system access.	× New towers and the gantry require Section 37 consent, planning approvals and updated wayleaves. × As with Option E-2, the temporary OHL diversion crosses Innova-owned land and is subject to presently unknown third-party obstacles.
	Neutral	Benefit	Benefit	Strong Benefit	Detractor

Qualitative assessment output

Option E-3 is preferred because it delivers the final Moffat cable configuration within the programmed Harker Energy Enablement works. Option E-3 is preferred because it integrates the final [redacted] Moffat cable configuration into the planned Harker Energy Enablement works. By comparison, Option E-2 would not use [redacted] cable lengths procured for the planned Harker arrangement, creating a risk of avoidable consumer cost if those cables cannot be cancelled, reused or reallocated. E-3 also reduces changes to the planned cable scope and aligns commissioning with the Stage 3 Moffat outage in [redacted]. As the shortlisted options have broadly comparable land and consenting risks, E-3 provides the stronger whole-project outcome through better programme integration, lower cost and reduced delivery risk.

PASE alignment

Option E-3 is not PASE-aligned because its mixed OHL, GIB and cable configuration is not a defined PASE primary or variant solution. The departure is limited to the interface required to connect the EHRE circuits into the new Harker 400 kV GIS.

This deviation is justified by the site-specific requirement to connect into the new Harker GIS within a constrained operational environment, where a fully air-insulated interface would not provide a compatible connection arrangement; as the connecting Harker substation utilises non-SF_6 gas-insulated technology. The targeted use of proven, non-SF_6 gas-insulated technology provides a compact and technically compatible interface between the Gretna overhead line and the new GIS, while Option E-3 limits GIB to approximately [redacted] metres of busbar, avoids more extensive cable congestion and reduces the high-value plant, civil works and delivery risks associated with the alternative.

Assessment of PASE-aligned alternatives

NGET assessed four interface arrangements, including extended gas-insulated busbar, diversion of both circuits into the GIS, diversion of the Gretna circuit while retaining and uprating the Moffat cable connection, and a combined gas-insulated and cable arrangement. The extended busbar and combined arrangements were discounted due to length, cost, road-crossing, security, space and construction constraints. Options E-2 and E-3 were shortlisted as technically compliant and deliverable solutions that enable substantial offline construction without simultaneous outages of both circuits.

Option E-3 was selected because it integrates the final Moffat cable arrangement into the programmed Harker works and enables the procured cables to be used within the final connection. Under Option E-2, [redacted] procured cable lengths would not be required, creating a risk of avoidable consumer cost if they cannot be reused or reallocated. Option E-3 also limits the gas-insulated busbar to approximately [redacted] metres and is lower cost than E-2.

Land and consenting risks are broadly comparable between the shortlisted options and were not determinative. Overall, E-3 represents a targeted and proportionate departure from PASE, providing the more coordinated and economic solution while aligning with the Harker delivery and outage sequence.

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. For each EUL, we have applied a 13.8% contingency, based on historic project analysis, to account for unforeseen circumstances and to mitigate risks during implementation.

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 Eligibility Letter (EL) / Needs Case (NC) stage, the current estimate includes a 13.8% 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.

Both cost estimates in Table 9 incorporate the entirety of the work required to increase the capacity of both circuits, including the OHL refurbishment works.

Table 9: Cost estimate breakdown

Options	OHL (£m)	Cables (£m)	Substation (£m)	Total (exc. risk (£m))	Biodiversity (5%)	Total (incl. 13.8% risk (£m))
Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

The substation costs presented in Table 9 include all equipment within the substation fence line, including the gantry. Cable costs are excluded because these are assumed to be delivered through the Harker Energy Enablement project.

Option E-3 is lower cost than Option E-2 primarily because it reduces the extent of GIS/GIB infrastructure required by adopting a hybrid solution, whereby the Gretna circuit is connected via an OHL and GIB arrangement, while the Moffat circuit is connected using cable infrastructure. This results in a substantial reduction in high-value GIS equipment, including a reduction in GIS

busbar length from [redacted], together with fewer associated primary plant items such as bushings, current transformers, voltage transformers and gantries. The reduced electrical scope also drives lower civil engineering requirements, including site infrastructure, fencing, access roads and demolition works. As a result, Option E-3 has a significantly lower base construction cost, which in turn reduces the associated biodiversity net gain allowance and risk and contingency provisions. Overall, Option 3 delivers the required network capacity enhancement while requiring materially less substation infrastructure than Option E-2, resulting in an overall cost saving of approximately [redacted]

Cost Drivers

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

- OHL Reconductoring – Transmission line uprating works
- GIS Busbar – New GIS electrical infrastructure
- Cut & Fill Civils – Major site earthworks and ground preparation
- Engineering Design – FEED, detailed design and technical assurance

Cost Benefit Analysis (CBA)

Purpose and approach

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 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 2 shortlisted options.

- Option E-2 - Divert the Gretna and Moffat overhead lines to the new Harker GIS substation
- Option E-3 - Divert the Gretna overhead line and uprate the Moffat cable connection

CBA outcome

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

Table 10: 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 E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces	[redacted]	[redacted]	[redacted]	[redacted]
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection	[redacted]	[redacted]	[redacted]	[redacted]

On the basis of the discounted lifetime CBA results (Table 10), Option E-3 delivers the highest NPV [redacted] 2023/24 base prices) and therefore represents the preferred option on consumer value grounds. Option E-2 delivers a lower NPV than E-3 [redacted] 2023/24 base prices). 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.
- Price base: 2023/24 prices, aligned to the Ofgem RIIO-ET3 CBA template inputs (including treatment of replacement Capital Expenditure (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 11: Summary of all additional Capex costs (2023/24 base prices)

Option	Initial works (£m)	Future replacement (40yr (£m))	Total costs (£m)
Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces	[redacted]	[redacted]	[redacted]
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection	[redacted]	[redacted]	[redacted]

Benefits

The following benefits have been included within the CBA:

- Carbon cost of construction reduction
- Summary of all Benefits

Table 12 presents the summary of all (undiscounted) benefits, including environmental and non-environmental benefits, considering the central base case carbon price.

Table 12: Summary of all benefits

Option	Environmental benefits		Total benefits (£m)
	Carbon costs of construction (£m)	Gas leakage (£m)	
Option E-2: Divert both Gretna and Moffat circuits into the new Harker GIS through OHL and GIB interfaces	[redacted]	[redacted]	[redacted]
Option E-3: Divert Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection	[redacted]	[redacted]	[redacted]

3.7 Preferred solution

Based on the combined outputs of our multifactorial assessment and CBA, Option E-3, Diverting Gretna into the new Harker GIS through an OHL and GIB interface and retain and uprate the Moffat cable connection, is our preferred solution. It removes the Harker interface constraint identified following submission of the RIIO-ET3 EJP and enables delivery of the approved circuit uprating.

Compared with Option E-2, Option E-3 adapts the Moffat cable connection already planned through the Harker Energy Enablement programme and requires only the Gretna overhead line to be diverted. It therefore enables the final Moffat cable arrangement to be incorporated into the planned Harker works, reducing changes to the delivery scope, additional system access, outage requirements and programme complexity. It also enables cables procured through the Harker Energy Enablement project to be used within the final Moffat connection.

Option E-3 requires less GIS/GIB equipment and associated civil infrastructure. Focussing on the scope for the incremental cable works only, and not the combined total EHRE project cost; Option E-3 has an estimated cost of £[redacted] million, compared with £[redacted] million for Option E-2, and provides the stronger NPV of -£[redacted] million, compared with -£[redacted] It therefore represents the most deliverable, proportionate and economic solution for consumers.

Option E-3 will deliver:

- diversion of the Gretna overhead-line circuit from the existing Harker substation into the new 400 kV GIS substation;
- extension of the Gretna GIB connection from the GIS building, including associated bay equipment, AIS equipment and a line take-off gantry;
- [redacted] new OHL towers, while retaining the existing [redacted] line towers;
- an additional Moffat cable run between the existing and new Harker substations, including cable boxes, sealing ends and associated equipment; and
- the associated GIS compound extension, earthworks, foundations, access, security and cable-route infrastructure.

Project benefits and outputs

Table 13: Summary of outputs and benefits

Output and proposed Price Control Deliverable (PCD):	**By December 2029, complete and commission the Harker interface works comprising:** • **diversion of the Gretna circuit into the new Harker 400 kV GIS substation through the new OHL and GIB interface, including three new towers and a line take-off gantry; and** • **installation of a third Moffat cable run per phase between the existing and new Harker substations, including associated cable boxes, sealing ends and interface works.**
Outputs and benefits	• Diversion of the Gretna overhead-line circuit from the existing Harker substation into the new 400 kV GIS substation; • extension of the Gretna GIB connection from the GIS building, including associated bay equipment, AIS equipment and a line take-off gantry; • [redacted] new OHL towers, while retaining the existing [redacted] line towers; • an additional Moffat cable run between the existing and new Harker substations, including cable boxes, sealing ends and associated equipment; and • the associated GIS compound extension, earthworks, foundations, access, security and cable-route infrastructure. • Increase thermal capability of the B6 boundary capability by approximately [redacted] as identified in the NOA7 refresh. Increase the thermal capacity on the Elvanfoot (Gretna) – Harker & Harker – Moffat 1&2 circuits to a winter post-fault rating of [redacted] MVA. • Reinforces the ability to manage peak loads on the network and prepares the network for new connections of renewable energy in Scotland. • Provides cable capacity compatible with the baseline [redacted] MVA OHL requirement and a [redacted] conductor solution, including [redacted], subject to type registration and subsequent technical assessment.

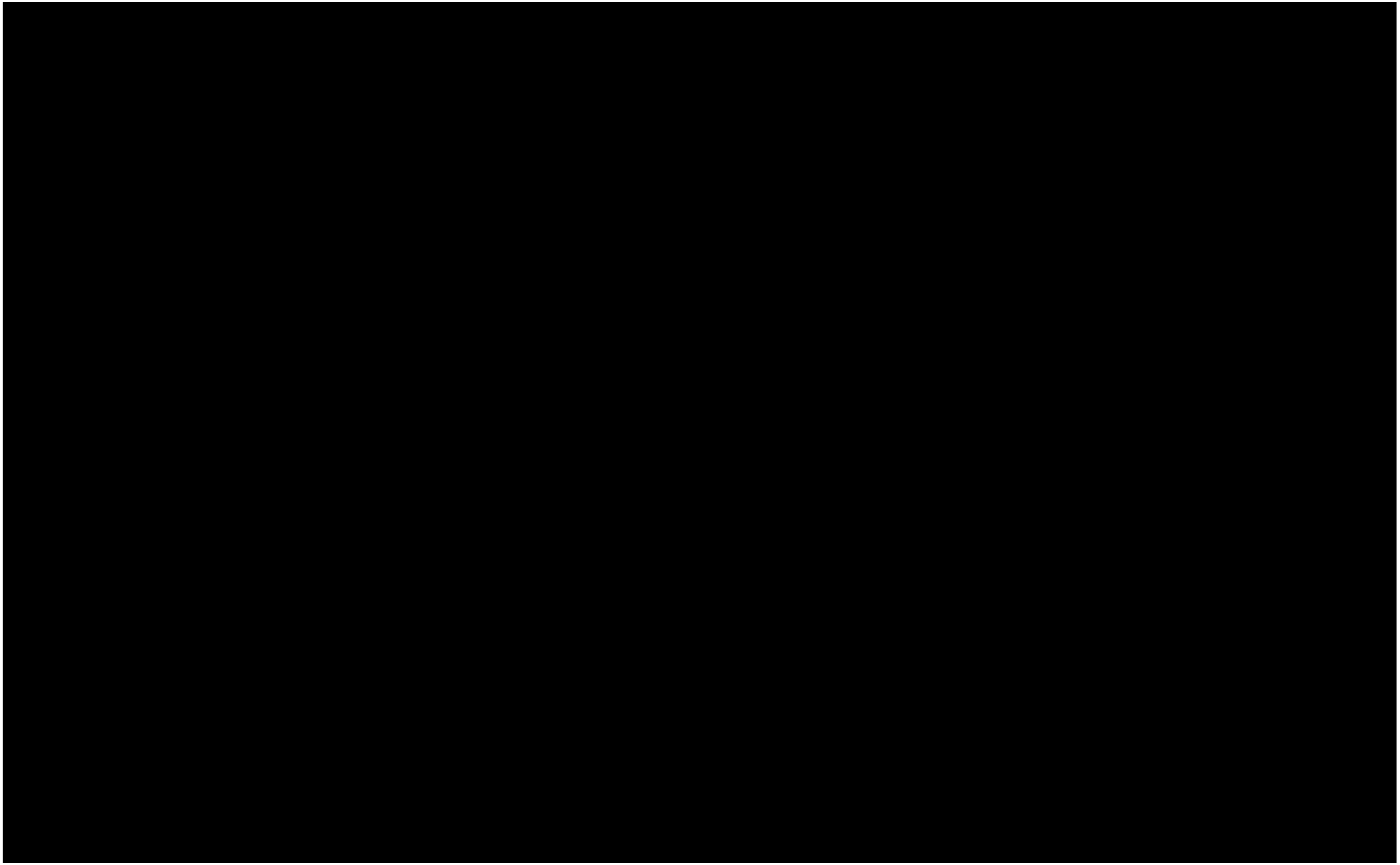
4. Delivery

4.1 Delivery year and indicative timeline

EHRE is scheduled to be energised by December 2029, ahead of the NESO-signalled 2030 network need date. Following energisation, final reinstatement, demobilisation and contractual close-out activities will continue, with contract completion planned by January 2031. Delivery of the required [redacted] winter post-fault capability and approximately [redacted] MW of additional B6 boundary capacity will therefore not depend on completion of the residual close-out activities.

Delivery will progress through development, surveys and land access, FEED, planning and consenting, procurement, detailed design, construction, commissioning and handover, with Early Contractor Involvement (ECI) supporting the detailed design of the Harker cable route and substation interface. The programme has been coordinated with Scottish Power Transmission and the Harker Energy Enablement circuit-transfer programme, taking account of system access and the currently approved 2029 outages. Delivery remains dependent on timely land access and consents, procurement of long-lead equipment, stable supply-chain and resource availability, and alignment of outages with adjacent works.

Figure 5 details the high-level program for Option E-3. These assumptions will be refined as design and procurement progress. distinguishes network energisation in December 2029 from the residual reinstatement, demobilisation and contractual close-out activities continuing to January 2031. The NESO-signalled network need date is 2030.



4.2 Procurement and contracting strategy

EHRE will use a coordinated split-delivery model aligned with the Harker Energy Enablement project and Scottish Power Transmission's adjoining works. [redacted]

The Harker [redacted]

The contractual change reflects the need to uprate the Harker interface to support the approved EHRE output of [redacted] MVA winter post-fault. Under Option E-3, the planned Moffat connection is modified to provide [redacted] while the Gretna circuit is diverted over approximately [redacted] metres of overhead line using three new towers and connected to the new 400 kV GIS substation through approximately [redacted] metres of GIB per phase. The Gretna diversion will use the [redacted] specification, providing a winter post-fault rating of [redacted] MVA and maintaining consistency with the wider EHRE reconductoring design. Ahead of conductor purchase, [redacted] against the required rating, type-registration status, route compatibility, programme and whole-life consumer value. The final selection will be confirmed at Project Assessment in coordination with Scottish Power Transmission.

A phased sanctioning approach will balance programme urgency, governance and increasing cost certainty. Timely sanction approvals are required to maintain programme momentum, secure long-lead GIS and GIB equipment, [redacted] activities and continue development of the substation scope as cost certainty improves. [redacted] This approach maximises the use of existing contracts and frameworks, aligns procurement and outages with the Harker Energy Enablement and SPT programmes, reduces mobilisation and interface risk, and progressively improves design maturity and cost certainty. The principal risks are timely sanction of long-lead equipment, cost uncertainty before Gate C and coordination between the OHL diversion and substation modifications. These will be managed through ECI, phased approvals, early supplier engagement and continued programme coordination.

This delivery strategy supports energisation by December 2029, ahead of the NESO-signalled 2030 network need date, with residual reinstatement, demobilisation and contractual close-out completed by January 2031.

Additional information regarding our procurement strategy and supplier selection will be presented in the Project Assessment.

4.3 Risks and risk management

An overview of current delivery risks is listed below along with mitigations. As risks continue to evolve, an updated detailed view of risk and mitigations will be supplied within the Project Assessment submission.

Table 14: Summary of risks and mitigations

Risk	Mitigation
Design and technical complexities: Detailed design is required to validate clearances, gantry arrangements and crossing methodologies. Due to insufficient sealing-end-tower clearance, inability to reuse existing gantries and towers, conflicts with stakeholder requirements and standards, and more complex road and restricted M6 crossings than anticipated.	Develop detailed scaffold design for all major crossings (including M6) to inform construction methodology, cost, and programme
Safety, Health and Security: Multiple schemes operating in the same Risk Management Hazard Zone (RMHZ), clearance infringements, and repeated access to the transmission system.	Computer-Aided Design (CAD) assessments indicate that the selected option can meet the applicable clearance requirements, subject to detailed three-dimensional modelling to confirm BESS-to-conductor separation distances and address any potential infringements.
Planning, Land and Consent: The option carries consenting, planning and land risks, including access and wayleave restrictions, determination delays, and higher-than-estimated reinstatement and acquisition costs.	Early engagement with planning authorities, landowners and affected stakeholders. Progress land rights, access agreements and wayleave negotiations in parallel with design development
Third Party Impact and Network Coordination: The option carries significant delivery and interface risks due to integration with the Harker Energy Enablement scheme, potential NESO outage changes, and complex M6, railway, river and Distribution Network Operator (DNO) cable crossings.	Early design development will support stakeholder engagement and integrate crossing requirements into delivery planning
Environment and Sustainability: The works carry construction carbon impacts and potential habitat loss where the OHL crosses a Site of Special Scientific Interest (SSSI).	The investment will minimise construction carbon through NGET's OHL design principles and carbon-neutral construction commitment, while ecological surveys and early agency engagement will limit habitat impacts and identify any BNG requirements, which are expected to be low given the temporary works and use of existing infrastructure
Planning, land and third-party rights: Delay in securing access, wayleaves, land acquisition or statutory consents could affect the construction sequence, require acceleration or alternative access arrangements and increase cost.	Progress land rights, access agreements, wayleave negotiations and planning submissions in parallel with detailed design. Continue early engagement with affected landowners, the BESS developer and relevant planning authorities, and update the cost and schedule exposure through quantitative risk assessment at Project Assessment.

5. Conclusion

This submission outlines a preferred solution to satisfy the investment drivers. It seeks confirmation of eligibility under Special Condition 3.18, confirmation of eligibility of PCF under Special Condition 3.15, confirmation of re-opener Track 2 Eligibility Letter and formal approval of the Needs Case and preferred solution.

The RIIO-ET3 EJP established the need for EHRE and secured baseline funding for the preferred [redacted] OHL reconductoring solution. Subsequent development identified the existing Harker cable arrangement as an additional limiting factor that would prevent delivery of the approved output. NGET has therefore assessed the available Harker interface solutions and identified the preferred option as Option E-3, as it provides the strongest overall balance of technical performance, deliverability, programme alignment and consumer value. This submission seeks approval only for the incremental cable and interface works and excludes the £[redacted] million baseline-funded OHL scope.

Table 15: Submission summary

Submission summary	
Main drivers	• **NESO**: NESO designated EHRE as HND Essential for delivery by 2030 to increase the circuits' winter post-fault rating to [redacted] MVA and provide approximately 400 MW of additional B6 boundary capability, supporting forecast north-to-south transfer requirements of almost 2[redacted] • **Asset Health**: [redacted] to reduce failure and outage risk.
Preferred option	Option E-3: Divert the Gretna overhead line and uprate the Moffat cable connection. Option E-3 is preferred because it removes the Harker interface constraint and enables the approved circuit uprating while avoiding abortive cable works, reducing infrastructure and delivery risk, and providing the strongest consumer value at £[redacted] million with an NPV of -[redacted] million.
Estimated cost and timing	Total project costs for EHRE: £[redacted] (including 13.8% risk and contingency in 2023/24 price base). This is split: • £[redacted] for reconductoring works, of which we have already had baseline funding approved in the RIIO-ET3 Final Determinations (out of scope of this submission) • £[redacted] for the Harker interface cable works (the scope of this submission) The required network output will be energised by December 2029, ahead of the NESO-signalled 2030 network need date. Final reinstatement, demobilisation and contract completion will conclude by January 2031.
Outputs	• **Deliver the Harker interface works:** Divert the Gretna overhead-line circuit into the new 400 kV GIS substation through an extended GIB connection, associated equipment, a line take-off gantry and three new towers, while retaining the existing [redacted] towers. • **Uprate the Moffat interface:** Install an additional cable run between the existing and new Harker substations, including cable boxes, sealing ends and associated compound, civil, access, security and cable-route works. • **Enable the approved network output:** Increase the circuits' winter post-fault rating to [redacted] MVA, providing approximately 400 MW of additional B6 boundary capability and supporting increased north-to-south renewable power flows and peak network demand.
Proposed PCD	Divert the Gretna overhead line to the new 400 kV GIS Harker substation and uprate the Moffat cable connection to remove the Harker interface constraint and enable delivery of the approved EHRE circuit rating and capacity uplift.

Appendix A
Glossary

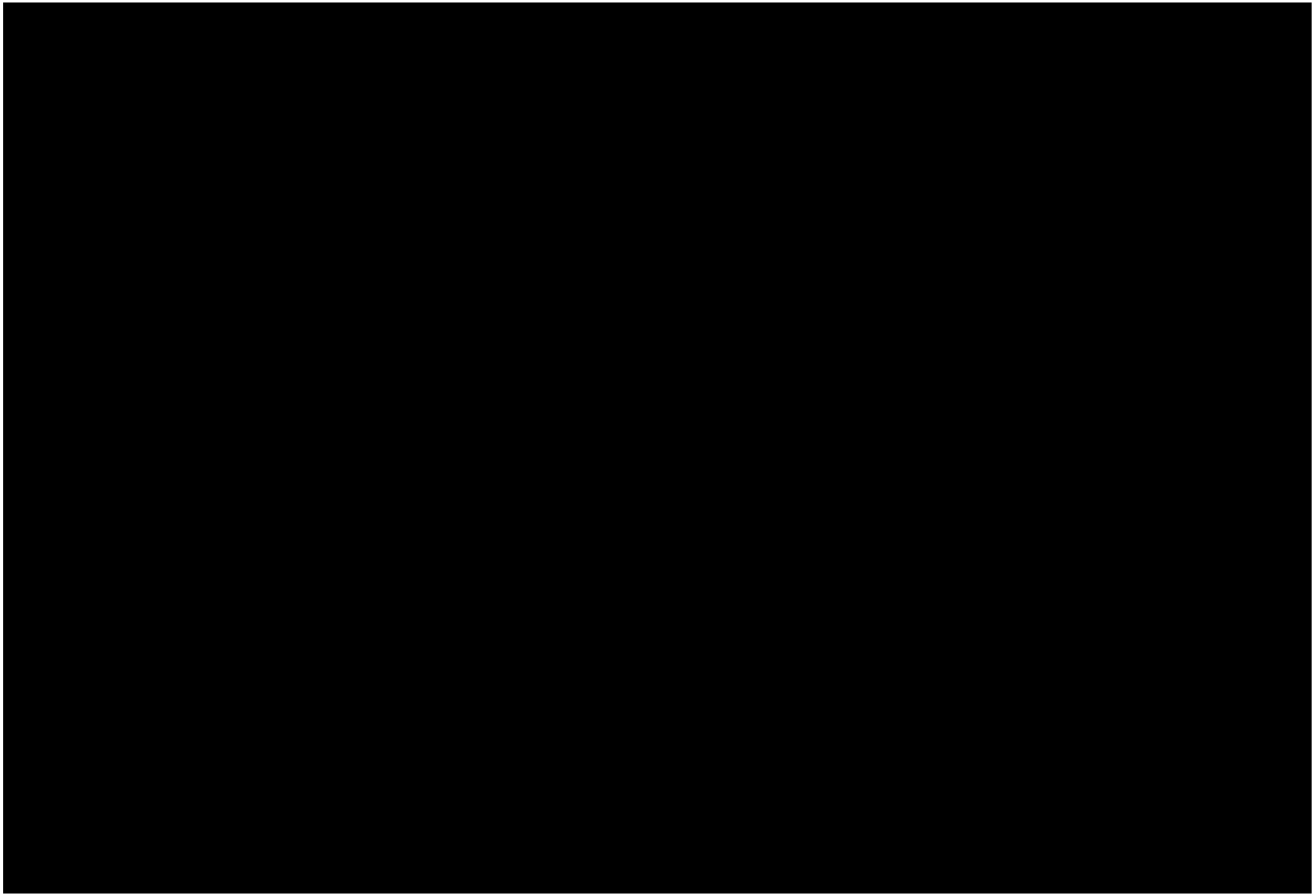
Table 16: Table of abbreviations and definitions

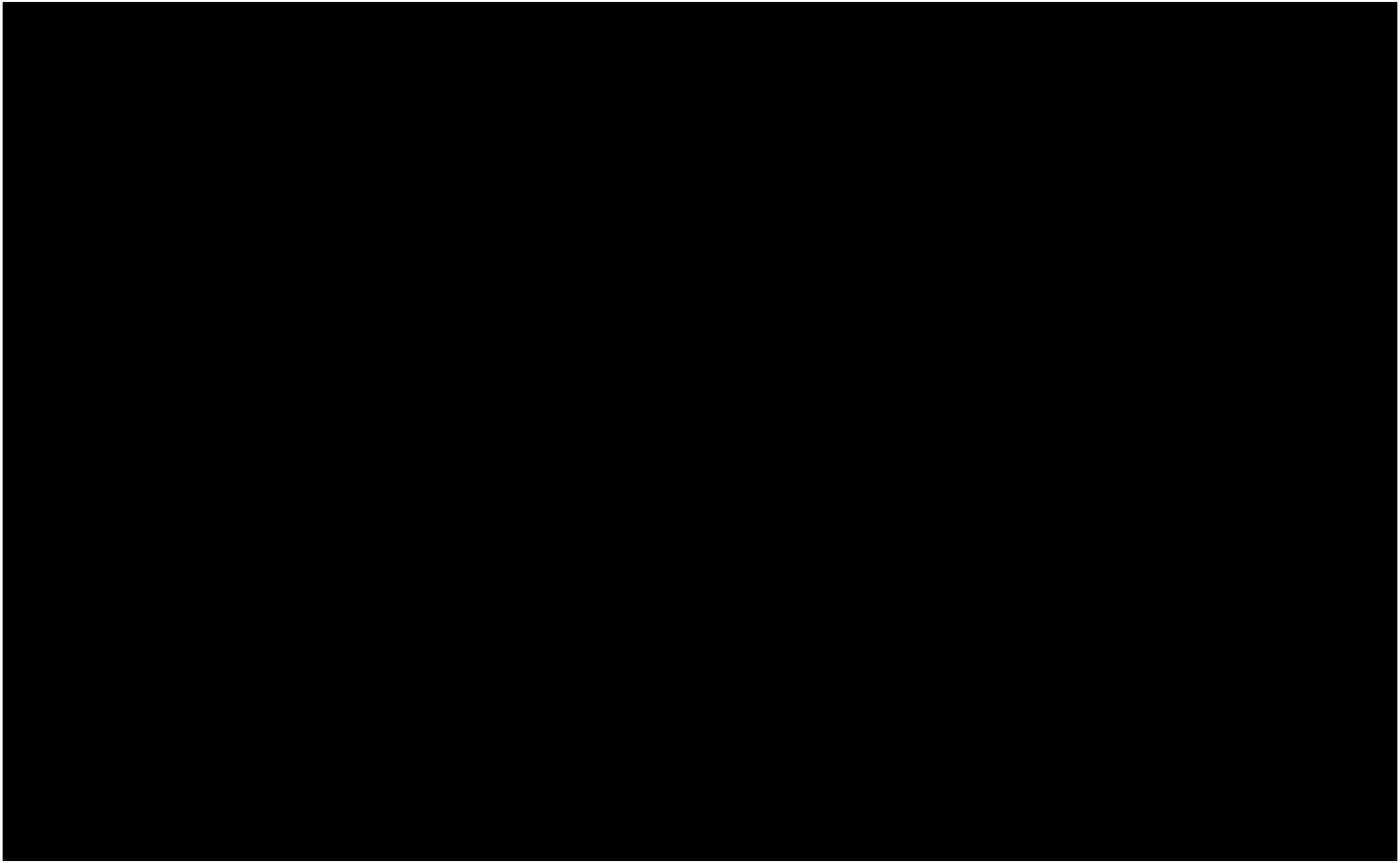
Abbreviation	Description
ACL	Available For Commercial Load
AIS	Air Insulated Switchgear
BESS	Battery Energy Storage System
BNG	Biodiversity Net Gain
BPDT	Business Plan Data Template
CAD	Computer-Aided Design
CAPEX	Capital Expenditure
CBA	Cost Benefit Analysis
DNO	Distribution Network Operator
EAWO	Early Asset Write Offs
ECI	Early Contractor Involvement
EEW	Early Enabling Works
EJP	Engineering Justification Paper
EL	Eligibility Letter
EoL	End-Of-Life
EUL	Estimating Units Lines
FEED	Front End Engineering Design
FY	Financial Year
GIB	Gas Insulated Busbar
GIS	Gas Insulated Switchgear
GW	Giga Watt
HND	Holistic Network Design
HV	High Voltage
HVDC	High Voltage Direct Current
IEC	International Electrotechnical Commission

Abbreviation	Description
kW	Kilo Watt
LV	Low Voltage
LVAC	Low Voltage AC
M&E	Mechanical And Electrical
MVA	Megavolt-Amperes
MW	Mega Watt
NC	Needs Case
NESO	National Energy System Operator
NETS	National Electricity Transmission System
NG	National Grid
NGET	National Grid Electricity Transmission
NOA	Network Options Assessment
NPV	Net Present Value
OESB	Operational Engineering Safety Bulletin
OHL	Overhead Line
OPGW	Optical Ground Wire
OTW	Omexom Taylor Woodrow
PASE	Pre-Approval of Solution Engineering
PCD	Price Control Deliverable
PCF	Pre Construction Funding
QCRA	Quantitative Cost Risk Analysis
QSRA	Quantitative Schedule Risk Analysis
RMHZ	Risk Management Hazard Zone
SDT	System Design Table
SF6	Sulfur Hexafluoride
SGT	Super Grid Transformer
SLD	Single Line Diagram
SPT	Scottish Power Transmission
SQSS	Security and Quality of Supply Standard
SSMD	Sector Specific Methodology Document

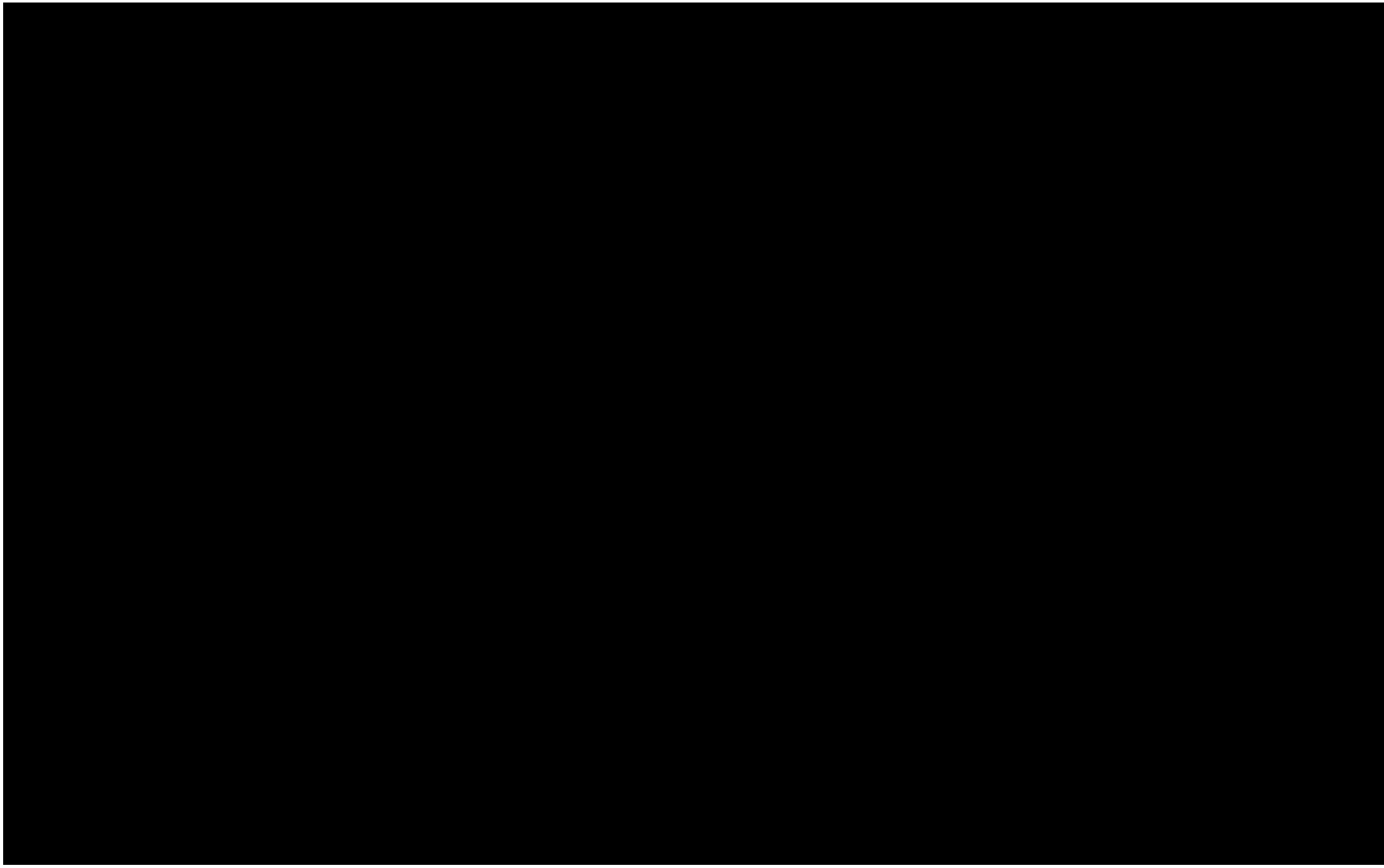
Abbreviation	Description
SSSI	Site of Special Scientific Interest
tCSNP	Transitional Centralised Strategic Network Plan
TO	Transmission Owner
UIOLI	Use-it or Lose-it
UK	United Kingdom
UKPN	UK Power Networks
WLCA	Whole-Life Cost Analysis

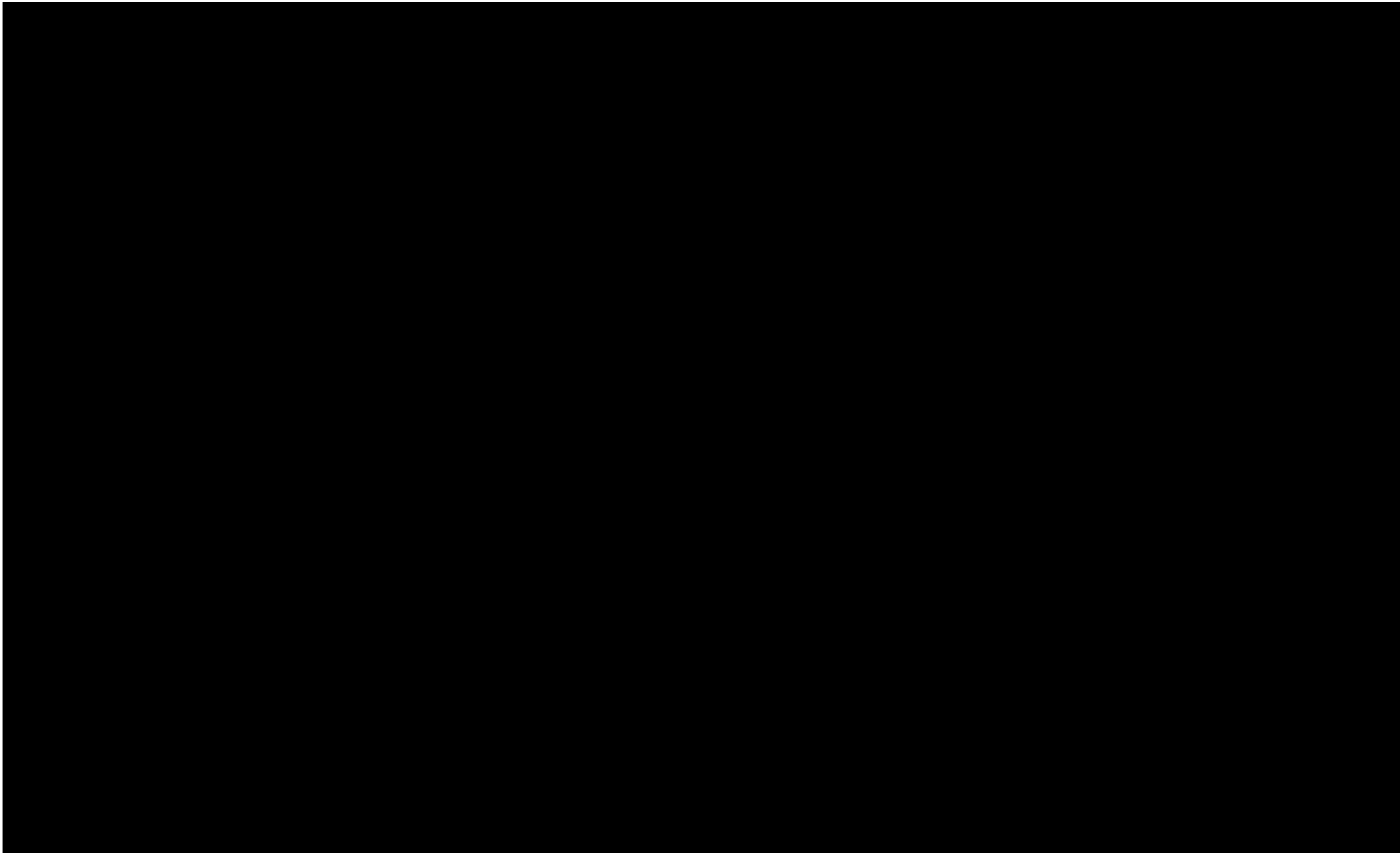












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