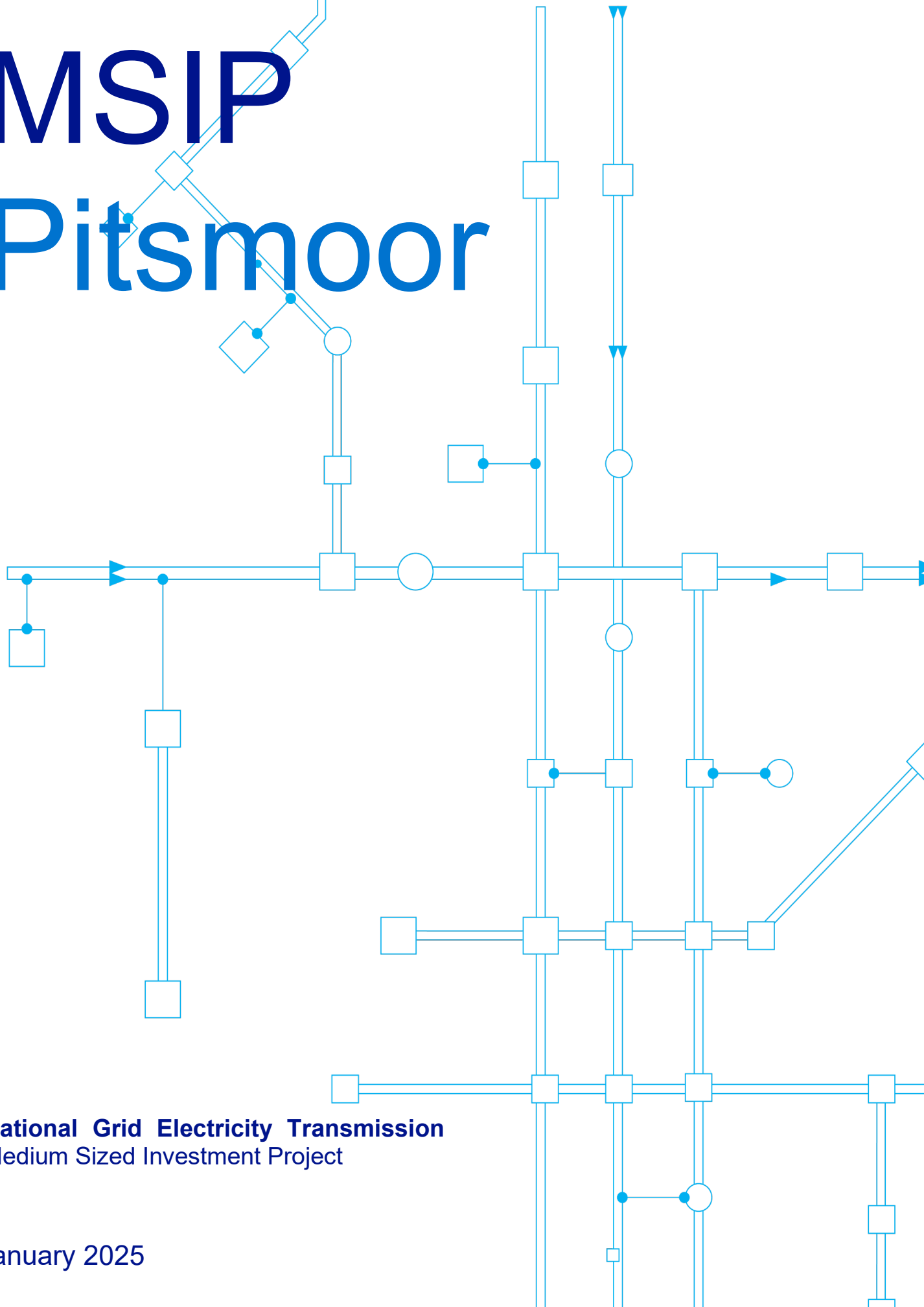
MSIP Pitsmoor



National Grid Electricity Transmission
Medium Sized Investment Project

January 2025

Contents

Investment Summary

Project Name	Pitsmoor 275kV Asset Replacement & Reconnection	**Delivery year**	[redacted]
Drivers for the Investment	**Non- Load Asset Replacement – investment driven by customer, Northern Powergrid's (NPG), decision to replace ageing shared 33kV switchgear that currently present operational and safety risks.** The shared 33kV assets, housed within NGET's 275/33 kV Pitsmoor Substation, are being replaced as part of NPG's construction of a new 33kV GIS substation. In response, NGET must undertake the necessary works to align and reconnect its existing 275kV equipment to the new 33kV GIS substation to ensure continued operational integration.		
Key considerations & challenges	Key considerations and challenges in delivering this investment include: • **Timelines:** there are multiple ongoing projects at Pitsmoor hence coordination of works is critical to avoid delays and further impacts. • **Technology:** the new circuit bays will utilise SF6 switchgear to align with NPG's solution, as no non-SF6 alternatives are currently available on the market for 33kV applications. • **Outages:** delays to outages would have knock-on effects on the project in terms of energisation of each circuit and planned works.		
Optioneering	We assessed 6 options across 4 overarching categories for addressing our ageing 33kV equipment and reconnecting the 275kV assets to the new substation. These included: • 3 option categories (doing nothing, market, and whole system solutions) which do not align with NPG's solution at Pitsmoor, focusing either on minimal intervention, unsuitable outsourcing, or overly broad system solutions. • 3 options to making use of the existing Pitsmoor substation via replacement and reconnection works, differing only on the specific configuration for the new cabling and respective civil works required. The scope of optioneering for integration of NGET's 275kV assets with the new 33kV substation was limited, because it is dictated by NPG's requirements which Ofgem has approved for RIIO-ED2. In identifying the best solution for consumers, our optioneering was focused on the element of cable replacement and reconnection works. We explored routing options for replacing the four existing 33kV SGT cable connections between Pitsmoor 275kV substation and the new NPG 33kV substation.		
Proposed Solution	**Cable Routing** Route 33kV cable circuits for SGT1 and SGT2 via the north and south site access roads, respectively, and SGT3 and SGT4 directly to the new substation. This ensures adequate cable spacing and meets the 120 MVA rating. **User Self-Build (USB) Connection Works** Install new 33kV SGT bays for SGT1-SGT4 with disconnectors, circuit breakers, current transformers, and earth switches. **Protection & Control related works** Modify 33kV SGT bay protection systems and update associated databases. **One-Off Works** Provide NPG with a 70kVA auxiliary supply by modifying the 275kV LVAC board. These works are outside the scope of this MSIP funding request as they are bespoke works funded by NPG.		
Outputs of the Investment	**Network reliability**: The project will replace ageing circuit breakers in NPG's substation rebuild, circuit protection and cables, ensuring the continued safe and efficient operation of the substation. The reconnection works are essential to maintain a reliable connection between NGET's 275kV transformers and NPG's system. By coordinating these asset updates with NPG's substation replacement, the project enhances overall network stability, reduces the risk of failures, and supports long-term reliability for both current and future electricity demand in the region.		

PCD Primary Outputs	Replacement and reconnection of cables for STG1-4 to new NPG 33k GIS substation, Installation of new 33kV SGT bays for SGT1-SGT4 & Protection and control related works - Delivery by [redacted]		
Estimated Cost (price base 2018/19)	Our total cost for the investment and funding allowance being sought is for: • The current estimated total cost of the project is [redacted] • The total direct cost of the project – the funding this MSIP seeks – is [redacted]		
Spend profile	**T2 (FY2022 – FY2026):** [redacted]	**T3 (FY 2027 – FY2031):** [redacted]	**T4+ (FY 2032+):**
Reporting table	Annual RRP – PCD Table	**PCD Modification Process**	Special Condition 3.14, Appendix 1
Historic funding interactions	No existing funding in RIIO-T1 or RIIO-T2. There are no Early Asset Write-Off costs associated with this investment.		

1. Executive summary

1.1 Context

This paper, together with the associated Cost Benefit Analysis (CBA), summarises NGET's proposed investment to carry out essential works at the Pitsmoor substation to facilitate the integration of Northern Powergrid's (NPG) asset replacement programme, and seeks to demonstrate the consumer interest in the associated investment. NPG are replacing their 33kV switchgear, which is connected to NGET's 275kV substation assets. To facilitate the new 33kV GIS substation at Pitsmoor, corresponding reconnection related works and timely asset replacements will be undertaken by NGET, in conjunction with NPG, to ensure integration and maintain system reliability.

This Medium Sized Investment Project (MSIP) seeks approval of the need for the investment, as well as approval of the proposed solution and requested funding allowances for efficient spend on the project.

1.2 What is the background to this Investment?

Pitsmoor Substation, located northeast of Sheffield City Centre, is a 275/33 kV AIS substation equipped with four Super Grid Transformers (SGTs), which step down voltage for regional electricity distribution. The site houses shared NGET and NPG 33kV switchgear assets, essential for serving the local distribution network.

In 2018, an NGET site inspection identified safety concerns with four NGET-owned 33kV transformer incomer circuit breakers at the substation. These issues could not be addressed by replacing the switchgear individually while retaining the existing metal-clad infrastructure, necessitating a broader replacement. NPG also conducted an independent site inspection, which confirmed the issues identified by NGET.

The existing switchgear issues were managed in collaboration with NPG via ongoing maintenance and monitoring to ensure equipment remained operational, with a view to the switchgear being changed in near future. The replacement of the substation infrastructure required alignment with a clear driver from NPG, which was subsequently confirmed by Ofgem under the RIIO-ED2 framework. NPG determined that their 33kV switchgear needed replacement due to asset age, lack of spare parts, and anticipated customer connection demands. Their plan involves replacing the existing 33kV switchgear with modern indoor Gas Insulated Switchgear (GIS).

To integrate the new 33kV GIS infrastructure with the wider 275kV substation, and to also address the existing condition of some of our 33kV assets as part of NPG's rebuild, corresponding upgrades and works must be undertaken by NGET.

1.3 What have we considered in developing options for this investment?

We carefully evaluated a range of options available for replacing and upgrading NGET's 33kV switchgear and cables at Pitsmoor Substation, in line with NPG's requirement for a new 33kv indoor GIS switchgear. As the scope for our asset integration with NPG is largely determined by their requirements, our options assessment focused on the cabling routing element of the project scope to ensure that the chosen routing solution was technically appropriate and resulted in safe and reliable operation of the substation.

We considered a total of three options in our optioneering process for the cable routes. Two of these options were first developed in early design, before our detailed design stage introduced an additional option.

The two initial cable route options (Options D-1 and D-2) were assessed against key criteria for the reconnection of two of NGET's supergrid transformers (SGT1 and SGT2) to NPG's new GIS substation. Option D-1 would route both SGT1 and SGT2 cables along the north site access road, whilst Option D-2 would take the route via the south side access road and behind the Pitsmoor control building. The remaining SGTs (SGT3 and STG4) did not require route planning as they will be in close proximity to NPG's new substation.

Value for consumers was a key consideration in our optioneering, with Option D-1 offering a more cost-effective and faster delivery timeline. Option D-1 involved shorter cable routes with fewer civil engineering challenges, while Option D-2 involved longer routes that passed through steep terrain, requiring more significant reinforcement work. With regards to our consideration of safety, we determined that Option D-2 posed greater risks due to the terrain and proximity to live equipment. From an environmental perspective, Option D-2 would require vegetation removal, whereas Option D-1 had a lower environmental impact.

During the detailed design phase, following the completion of our initial optioneering, it was identified that we would need to consider a hybrid solution for the cable runs. This was because we identified the need for greater phase separation to avoid thermal interference between cable when passing below existing trough runs on the north route. This constraint meant that Option D-1 for both SGT1 and SGT2 circuits to follow the north route could not be progressed.

Option D-3 was therefore introduced at this stage to address this constraint, and this option proposed for the SGT1 cables to be run along the south site access road and in front of the Pitsmoor control building, which was not initially preferred due to the presence of trough crossings. However, design developments and risk considerations determined that Option D-3 would mitigate the risk of trough crossing interference via careful excavation. SGT2 cables would be run via the north site access road.

Table 1 below provides a high-level summary of how the options compare against key criteria for the project.

Table 1: Summary of cable routing options against key criteria

Criteria	Initial Option		Further Option
	D-1	D-2	D-3
H&S Safety Risk: slopes on cable route	safer: no steep slope	steep slope	one safer north route, one in front of the control building with no slopes
Civil Works: construction complexity	less complex	steep slope behind control room and longer route	need to pass under the services in front of the control building
System Access: proximity outages	outages may be required	outages may be required	outages may be required
Technical Performance: thermal interference of 120MVA rating	insufficient space to maintain phase separation under existing troughs	allows phase separation	allows cable phase separation on both routes with adjustments
Capital Cost: cable length and civil works	lowest cost, driven by shorter cable route	highest cost, driven by longer cable and higher complexity civil works	moderate cost- higher than option D-1 but less than option D-2 shorter than Option D-2. Avoid costs associated with complex civils
Environmental Disruption and sustainability	minimal	vegetation disruption	minimal
Programme: timing for civil works and cable route	expected to be shortest	likely the longest programme due to required civils	relatively moderate – between Option D-1 and D-2
Land: consents and rights	no consent required - within NGET boundary	no consent required - within NGET boundary	no consent required - within NGET boundary

1.4 What is the preferred option and what outputs does it deliver?

NPG are to build a new 33kV indoor GIS substation to replace the existing 33kV switchgear. The GIS substation will be situated in a new location within the Pitsmoor compound. NGET propose the following works as necessary to efficiently integrate NPG's new build with NGET's existing infrastructure at Pitsmoor substation:

- replace and reconnect the 33kV high voltage cables connecting NGET's SGTs to NPG's new indoor 33kV GIS substation via optimal route of Option D-3 to ensure a 120MVA can be achieved without thermal interference.
- works to be carried out by NPG (USB works) to NGET specifications and ultimately be owned by NGET – installation of fully equipped 33 kV switchgear bays at the new 33 kV NPG substation for the SGT1, SGT2, SGT3 & SGT4 circuits, including busbar disconnectors, circuit breakers, current transformers and earth switches.
- Modification/replacement of 33kV SGT bay protection system and associated database changes for new SGT bays.

The proposed solution delivers value to consumers by modernising the substation infrastructure and replacing assets that have been in operation for an extended period. This investment will safeguard the operational integrity of the connected systems, maintaining the resilience and reliability of the regional electricity network. Funding allowances are sought as part of this MSIP submission. The direct costs for this investment are estimated at [redacted] Further details related to the makeup of these requested allowances are detailed within the cost model available alongside this submission.

1.5 How has future proofing been considered in the proposed investment?

The upgraded infrastructure will support NPG's requirements while remaining within the designed 120MVA capacity. At present, there are no known plans to increase capacity beyond 120MVA, as the project is driven by NPG's current asset replacement requirements.

An additional driver for NPG in initiating the 33kV substation replacement includes a new customer connection application upgrade from Sheffield Forgemasters for a 95MVA Firm connection.

1.6 What are the uncertainties and how have they been accounted for?

- Delays to planned outages present a key risk, as they would affect the energisation of each circuit and potentially disrupt wider planned works. Managing the schedule for outages is critical to avoid delays that could cascade into other parts of the project, impacting both cost and delivery timelines.
- The project requires careful coordination between NGET and NPG to avoid delays that could have significant knock-on effects, particularly regarding the commissioning of Super Grid Transformers (SGTs) and associated installations. Any misalignment between the two parties could impact overall project timelines and delivery.

Summary

Ofgem approved NPG's proposed asset replacement at Pitsmoor via the construction of a new 33kV GIS substation, requires NGET to replace and reconnect 33kV circuits from its four Super Grid Transformers (SGTs) to NPG's new indoor GIS substation. The development also requires NGET to replace its own 33kV switchgear housed within the new shared infrastructure.

NGET's preferred option for the cable routes is the optimal configuration, prioritising the avoidance of thermal interference between the high voltage cables, ensuring system reliability and futureproofing for 120MVA capacity. This delivers an efficient solution for consumers that ensures long-term operational efficiency.

2. Introduction

2.1 Project background

Pitsmoor Substation is located within NGET's Northeast region, and within the city of Sheffield in South Yorkshire. It is a NGET owned 275/33 kV Air-Insulated Switchgear (AIS) outdoor four-switch mesh substation equipped with four Super Grid Transformers (SGTs). These transformers step down voltage for regional distribution and provide connections to Northern Powergrid's (NPG) local electricity distribution network.

Super Grid Transformers:

- SGT1 and SGT2 are rated at 120 MVA.
- SGT3 and SGT4 are rated at 100 MVA.
- All four transformers feed into the NPG 33 kV substation via 33 kV cables.

Feeder Circuits:

- Pitsmoor substation connects to other key substations via 275 kV feeder circuits: Neepsend, Templeborough, Wincobank, and Norton Lees.

The existing 33 kV Substation is currently owned and operated by NPG except for four bays associated with the SGT1, SGT2, SGT3 and SGT4. These SGT bays are currently owned and operated by NGET.

Northern Powergrid (NPG)

Northern Powergrid (NPG) are one of the six licensed Distribution Network Operators (DNOs) in GB. It is responsible for managing and operating the electricity distribution network across the northeast of England, Yorkshire, and northern Lincolnshire. Accordingly, NPG are responsible for managing and operating the 33 kV switchgear at Pitsmoor for delivery of low voltage electricity to end consumers in the region.

2.1.1 MSIP Eligibility

The Pitsmoor substation project qualifies for MSIP eligibility under SpC 3.14.6 Category (b) as a demand connection project, which includes addressing identified issues with infrastructure necessary to maintain our customer's connection to the transmission network via Pitsmoor substation.

Our proposed scope of works, as described in this MSIP funding request, is in response to our customer initiating a replacement of the ageing 33kV switchgear at Pitsmoor with a new GIS substation. This upgrade will ensure a reliable connection for NPG, enabling them to continue meeting regional power demands as a DNO.

While Pitsmoor does not currently meet the £11.84m variance threshold (with estimated costs marginally below at approximately [redacted] we are submitting this as an atypical MSIP reopener as agreed with Ofgem. This is due to the potential for contracted costs, expected to be obtained in [redacted] which could cause the project costs to exceed the £11.84m variance. This submission mitigates the risk of underfunding the project and ensures readiness to proceed without delays should costs increase, so that the project can continue and realise the benefits for consumers in terms of a secure electricity system.

2.1.2 Chronology to the request

Identification of issues with existing switchgear (2018)	• An NGET site inspection identified safety issues related to 33kv circuit breaker connection assets which presented several risks. • NPG carried out an independent site assessment which confirmed issues and resulting risks identified by NGET.
Interim management of risks (2018 onwards)	• NGET and NPG collaborated to mange the identified risks through maintenance and monitoring, ahead of NPG initiating a full replacement for RIIO-ED2.
NESO DNO/Demand Application (2020)	• NPG/NESO application to NGET for proposed works for the Pitsmoor construction project.
NPG scheme approval (2021)	• NPG scheme approved ahead of RIIO-ED2 to replace the 33kV outdoor AIS switchgear with indoor Gas Insulated Switchgear (GIS).
TOCA Signed (2021)	• NGET-NESO construction agreement signed,.

Despite identifying asset health issues related to our switchgear (circuit breakers) in 2018, NGET could not trigger standalone asset replacement works as the metalclad infrastructure is shared with NPG and their switchgear would also need to be replaced as part of a coordinated solution.

Although NPG confirmed the same asset health issues via their own independent site inspection, progress was contingent on NPG confirming a driver for complete replacement of the 33kV infrastructure and switchgear. Until such a driver was established, NGET continued to manage the 33kV switchgear in coordination with NPG through monitoring and maintenance until NPG raised a needs case, which was subsequently approved by Ofgem under the RIIO-ED2 price control framework. NPG's approved proposal is for a new 33kV GIS substation to replace the existing 33kV switchgear.

NPG/NESO made a demand application to NGET for proposed construction works at Pitsmoor in December 2020 and a TO Construction Agreement (TOCA) between NGET and NESO was subsequently signed in December 2021.

In alignment with NPG's approved replacement of the 33 kV switchgear, NGET must undertake corresponding works at the site. The planned replacement of the Pitsmoor 33 kV switchgear by NPG and the associated works by NGET represent a coordinated effort to modernise the regional infrastructure at Pitsmoor substation.

2.2 Regional and strategic context

The NGET Northeast region is split into sub-regions of Northeast, Yorkshire & Humber, and Trent Valley/Lincolnshire. The substations and connecting circuits in these areas of the network have complex multi-investment driver requirements.

The Northeast and Yorkshire region has a strong industrial heritage, with areas like Teesside, South Yorkshire, and West Yorkshire historically known for steel production, chemical industries, and manufacturing. These industries have high energy demands, necessitating a robust transmission network.

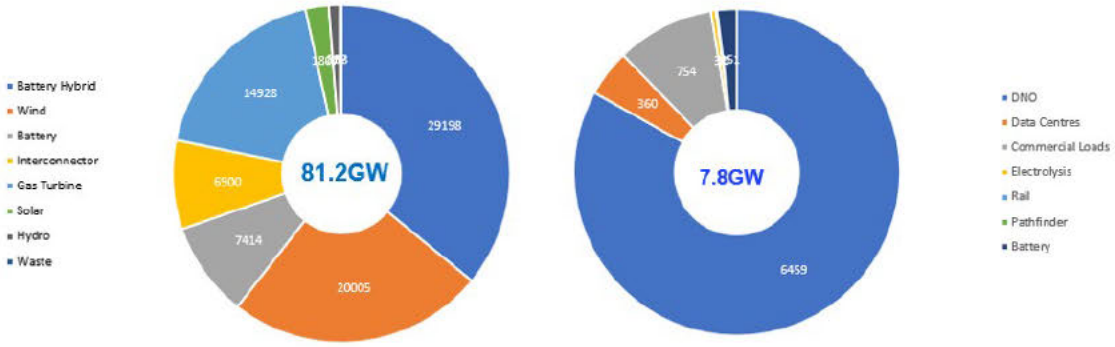
The increasing volume of intermittent generation and additional interconnectors in the region will create dynamic network challenges that will require additional infrastructure to manage. Electricity

demand is expected to grow over the next 20 years as the Northeast continues its decarbonisation journey. Balancing demand growth with increasing embedded generation is a key focus for NGET, as it will determine the need for new transmission infrastructure in the coming decades.

Customer Connections

Within the Northeast, there is around 81.2GW of Generation contracted and 7.8GW of Demand contracted out to 2034 wanting to connect to NGET's infrastructure. However, there is a strong likelihood that not all of this demand will connect due to various factors.

Figure 1: Northeast Contracted Generation & Demand Connection Offers (MW) to 2034



2.3 How does this investment relate to our T3 submission

NGET are actively managing the highest-risk assets at Pitsmoor 275kV through targeted replacements. Replacement initiatives for several assets classed as high or very high risk, including [redacted] have been included in our RIIO T-3 business plan submission. The current approach at the 33kV, which forms this MSIP submission is driven by the customer, NPG, whereas the 275kV proposed works are driven by internal asset health concerns. These replacements are therefore being pursued independently of each other.

More broadly, our approach for RIIO-T3 in the Northeast region is to work with key stakeholders to identify and develop strategic network upgrades in line with our design principles. We have identified opportunities to work with NPG on whole system solutions, particularly at high-voltage substations where asset health interventions will be required over the next decade. These will be delivered through a mix of major projects and incremental upgrades, addressing key issues such as asset replacements, building condition challenges, and SF6 emissions.

2.3.1 Alignment with Ofgem's RIIO-T3 consumer outcomes

Table 2: Investment alignment with Ofgem's consumer outcomes

Secure and Resilient Supplies	The investment enhances the reliability of the regional network by replacing ageing infrastructure, reducing the likelihood of faults and outages, and ensuring a stable electricity supply to homes, businesses, and public services.
High quality of service	Reducing the risk of outages and ensuring a stable electricity supply contributes to a higher quality of service for consumers, minimising disruptions and maintaining reliability.
System efficiency and long-term value for money.	By coordinating infrastructure replacement to avoid duplication and unnecessary costs, the investment ensures cost-effective delivery. Additionally, modern equipment requires less maintenance, reducing long-term costs in the best interests of consumers.

3. Establishing Need

3.1 Overview

Key messages

Both NGET and NPG have identified significant issues with the ageing 33kV switchgear at Pitsmoor Substation, necessitating a coordinated effort to modernise the shared infrastructure. Ofgem approved NPG's driver for the replacement of their existing 33kV switchgear at Pitsmoor Substation as part of the RIIO-ED2 framework. The approval reflects the need to address identified issues with the existing switchgear confirmed by NPG.

- **Operational Risks:** the outdoor 33kV Air Insulated Switchgear (AIS), installed between 1968 and 1970 is deteriorating and poses increasing risks of equipment failures.
- **Safety:** site inspections conducted by both NGET and NPG revealed ageing components and risks associated with oil-based switchgear which could result in potential failures that could endanger personnel, impact the environment, and compromise the stability of the network.

To address the identified asset risks, NPG are driving the replacement of their switchgear, requiring NGET to replace its own switchgear also housed within the existing shared infrastructure and to undertake corresponding works to integrate and reconnect the new GIS substation with the existing 275kV substation.

The NPG Pitsmoor 1/2 and 3/4 33kV switchgear circuit breakers are all South Wales Switchgear ET1 type. This switchgear was installed between 1968 and 1970.

- Pitsmoor 1/2 33kV switchboard consists of 13 circuit breakers – 2 NGET owned and operated transformer incomer circuit breakers, 1 bus section circuit breaker, and 10 feeder circuit breakers, of which 4 are currently in service (3 for Forgemasters and 1 as 33kV interconnector to Pitsmoor 3/4). The remaining 6 circuit breakers are spares.
- Pitsmoor 3/4 switchboard consists of 15 circuit breakers – 2 NGET owned and operated transformer incomer circuit breakers, 1 bus section circuit breaker and 12 feeder circuit breakers, one of which is the interconnector to Pitsmoor 1/2.

3.2 Asset Health Drivers on the Pitsmoor 33kV Switchgear

Site Inspections

In 2018, NGET conducted a site inspection at Pitsmoor substation, where it owns four 33kV oil circuit breaker connection assets. For visibility, NGET briefly summarised our 2018 inspection below and provided the current asset health of NGET's circuit breakers.

Our inspection identified safety and operational issues related to our circuit breakers including:

[redacted]

At the time, NGET recommended remediation to address these safety risks, including overhauling shutters, racking mechanisms, and control systems. Figures 2 and 3 below illustrate some of the identified circuit breaker issues.

NPG carried out their own independent assessment in 2018 of the 33kV switchboards from which they confirmed their agreement with the issues stated by NGET, in that they are present on the NPG owned assets register. [redacted]

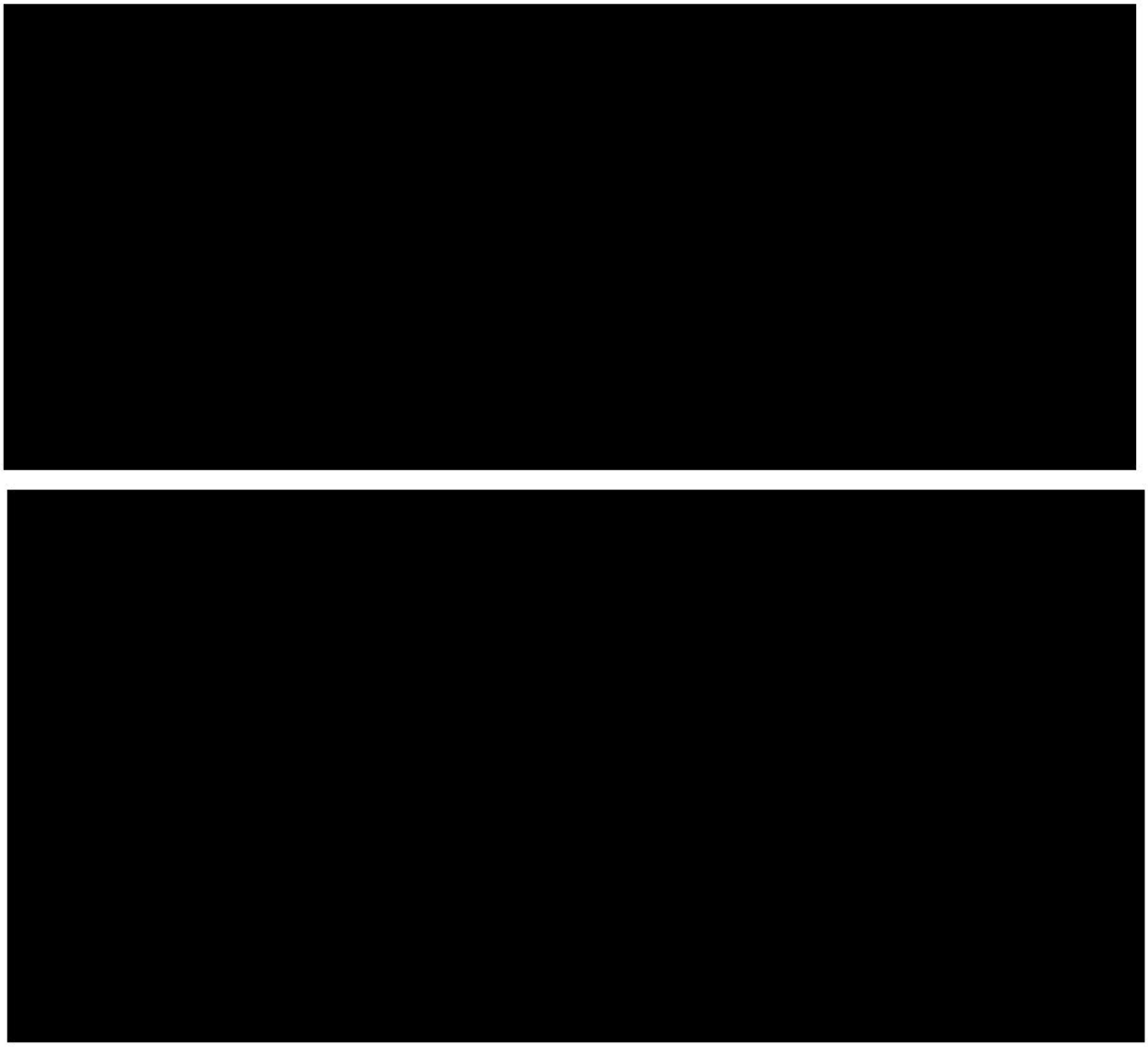


Figure 3: Elevation of Interlock location for the shutters requiring operation at height

Current Asset Health

[redacted]

Table 3: Current Asset Health Data for NGET's 33kV Circuit Breakers at Pitsmoor (2024)

Asset Type	Description	Fitment Date	Health Scoring Methodology	EoL 2024 (Present)	EoL 2026 (End of T2)	EoL 2031 (End of T3)
Oil Circuit Breakers	[redacted]					
Oil Circuit Breakers						

Oil Circuit Breakers	[redacted]
Oil Circuit Breakers	

3.2.1 Shared Infrastructure considerations & interim management of risks

NGET considered that the 33kV switchgear infrastructure is a fully integrated, metal-clad facility with bulk oil circuit breakers. This metal-clad switchgear was designed and installed in a different era, with outdated switching methods that necessitate local management. Due to the design of the metal-clad facility, NGET's circuit breakers cannot be individually replaced while retaining the existing infrastructure. Consequently, any major replacement effort would require coordination via NPG initiating a needs case driver, as the infrastructure is shared.

In the interim, NGET continued to work with NPG to manage the identified issues by implementing ongoing maintenance and monitoring, ensuring the equipment remains operational until the switchgear can be fully replaced in the near future.

3.2.3 Pitsmoor 33kV Replacement Scheme Approval

NPG initiated a scheme [redacted] to replace their 33kV outdoor AIS switchgear with an indoor Gas Insulated Switchgear (GIS) substation to address the identified risks. Additional drivers for them included [redacted] the need to accommodate a new customer connection application upgrade from Sheffield Forgemasters for 95MVA Firm connection. The need case for NPG's proposed scheme was subsequently approved by Ofgem under the RIIO-ED2 price control.

In response to NPG's approved project driver, the scope of this MSIP funding request covers the necessary works required to integrate and reconnect NGET's existing 275kV SGT's to the new substation, including protection and control works. As NGET's bays for SGT1-4, which include associated circuit breakers, will need to be housed within the existing 33kV infrastructure to be replaced by NPG, new SGT bays are required to be included in the scope of works.

This necessary scope of works for NGET to coordinate with NPG is summarised as follows:

User Build works

- As part of the commissioning of the new 33kV substation infrastructure, and under User Self Build (USB) model[1], NPG will carry out installation of new 33kV SGT bays for SGT1, SGT2, SGT3 and SGT4, including busbar disconnectors, circuit breakers, current transformers and earth switches.

[1] The USB model allows NPG to manage and deliver the works directly, enabling them to align the SGT bays with their operational requirements and timescales for the new 33kV substation. Once the installation of the SGT bays are complete and has been validated to meet all technical and operational standards, the ownership and ongoing responsibility for the SGT bays will transfer to NGET for operation and maintenance.

NGET reconnection works

- There is a need for replacement of the existing 33kV SGT1, SGT2, STG3, SGT4 cable connections from Pitsmoor 275kV substation to the new NPG 33kV substation bays which will be sited at a new location within the Pitsmoor compound.
- Modification/replacement of 33kV SGT bay protection system
- Necessary database changes associated with the installation and commissioning of the new 33kV SGT bays.

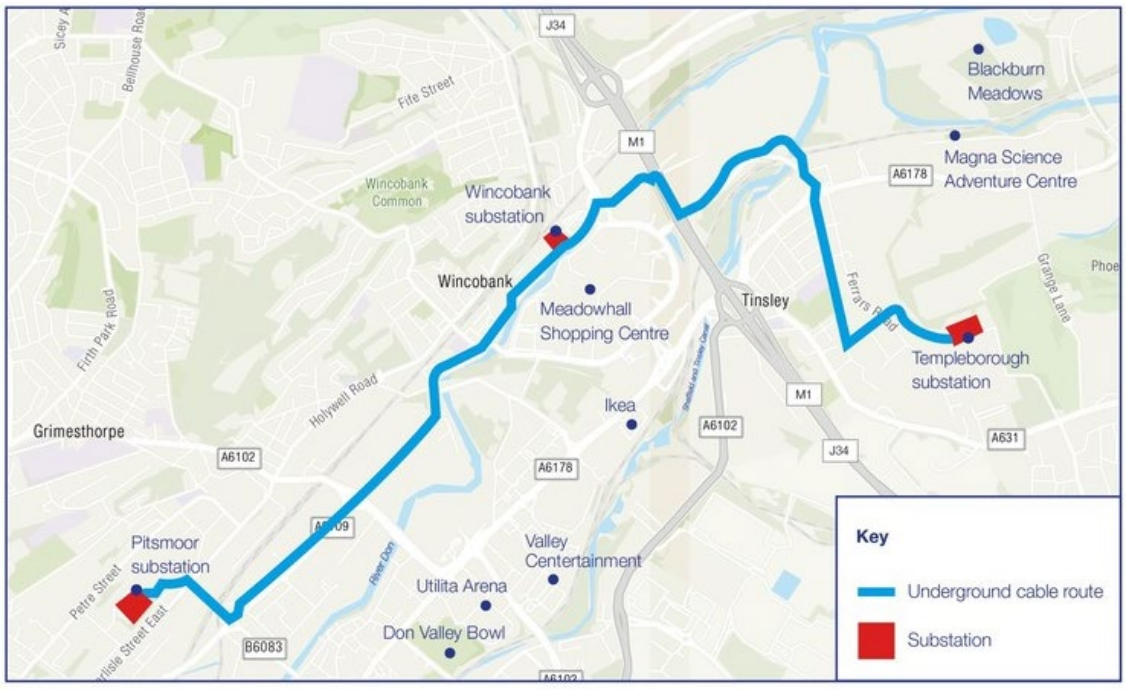
There are also one-off works required for modification or extension of the existing 275kV substation's Low Voltage Alternating Current (LVAC) board and associated equipment. These works are necessary to provide the NPG with a 70kVA auxiliary power supply to each of their new 33kV substation LVAC boards. While these one-off works are essential for the completion of the project, it is not covered under the current MSIP funding request as this is a bespoke task that applies only to this instance and will therefore be funded by NPG.

3.3 Existing and planned future network

Pitsmoor plays an important supporting role in Sheffield's electricity distribution network, facilitating the delivery of power to residential, commercial, and industrial users across the region. The substation connects major circuits to regional substations Neepsend, Templeborough, Wincobank, and Norton Lees.

The scope of works at Pitsmoor substation are a standalone customer asset health driven project, however, there are broader site and circuit driven initiatives in the region. For example, there are currently ongoing schemes to replace three existing underground cable routes between Pitsmoor, Wincobank and Templeborough substations in order to ensure secure and reliable power supply to homes and businesses in Sheffield and the surrounding area. The project will mean that increased electricity demand, both currently and into the future, can be met. These assets form part of what is currently referred to as the Sheffield 275kV ring. NGET continue working together with NPG on a networks solution for the management ageing transmission assets in the Sheffield Ring and a potential longer-term rationalisation of the network that meets future requirements whilst delivering consumer value.

Figure 4: Sheffield 275kV ring and the planned cable route



3.4 Scheme Progression

NPG has demonstrated clear progress by mobilising to the site and initiating engagement with their principal contractor, [redacted] This provides a high level of confidence that the project is actively moving forward.

[redacted]

4. Optioneering

As the scope for integrating our assets with the NPG rebuild is primarily dictated by their specific requirements i.e., the location and design of their new 33kV GIS indoor substation, our options assessment was concentrated exclusively on the cable routing element of the project. This involved developing a design that maintained proper thermal performance and phase separation of the cables, while also minimising construction complexity, environmental disruption, and safety risks.

Table 3 below summarises our initial assessment of options to address the needs case established in the previous section. In summary:

- Options A-C were discounted because they do not align with NPG's driver to address the specific operational, safety and infrastructure challenges at Pitsmoor, focusing either on minimal intervention, unsuitable outsourcing, or overly broad system solutions.
- Two sub-options (Option D-1 and D-2) were taken forward to detailed assessment, differing solely on the cable routes to reconnect 2 of NGET's SGTs to NPG's new 33kV substation.
- The initial preferred option was Option D-1, as NGET identfied this option as the optimal and lowest cost cable routing at the initial design stage. However, during detailed design NGET identified improvements in the design to provide the necessary phase separation of the cables, which resulted in us developing Option D-3. Option D-3 was a hybrid solution of Option D-1 and Option D-2.
- NGET consider Option D-3 is the best routing for the cables to achieve adequate phase separation while minimising cost to consumers.

4.1 Assessment of options

As above, a summary of our assessment of the initial options identified to integrate with the new 33kV GIS substation need is set out in Table 4 below.

Table 4: Summary of initial options assessment

Option	Option title	Option description	Taken Forward to Detailed Optioneering?	Rationale
A	Do minimum	Maintaining the current infrastructure with only essential interventions, such as limited repairs or temporary solutions to keep the substation operational.	**Not taken forward**	**Failure to address identified risks** It would leave identified risks unresolved, potentially leading to equipment failure or operational impacts, making it an unsustainable solution. Moreover, this would not align with NPG's already approved substation replacement.
B	Market-based solution	Outsourcing the responsibility for addressing the connection needs to a third party, such as an independent developer or operator, to provide the necessary infrastructure.	**Not taken forward**	**Inappropriate solution to meet the driver** Pitsmoor reconnection works involve transmission and distribution integration, requiring direct involvement from NPG and NGET to meet the technical and regulatory requirements.
C	Whole systems solution	Integrating the reconnection works into a broader strategy that considers the wider energy system (transmission, distribution, and potentially generation)	**Not taken forward**	**Inappropriate solution to meet the driver** The Pitsmoor works are highly localised and specific to both the customer and substation's operational and safety challenges. Introducing whole systems considerations could complicate the project at the expense of addressing the immediate needs at Pitsmoor.
D-1	Use existing substation/assets – reconnection of SGT 1 – 4 to NPG's new 33kV GIS substation	NGET connects SGT1 and SGT2 cables to NPG's new substation via the north site access road. SGT3 and STG4 are connected adjacently.	**Taken forward to detailed assessment**	**Viable route for asset reconnection** In light of NPG's construction of a new 33kV GIS substation to address asset health, operational, and safety challenges, this option offers a viable route for the reconnection of NGET's transformer to the NPG's new substation.

Option	Option title	Option description	Taken Forward to Detailed Optioneering?	Rationale
D-2	Use existing substation/assets – reconnection of SGT 1 – 4 to NPG's new 33kV GIS substation	NGET connects SGT1 and SGT2 cables to NPG's new substation via the south site access road, and behind the Pitsmoor control room. SGT3 and STG4 are connected adjacently[2].	**Taken forward to detailed assessment**	**Viable route for asset reconnection** In light of NPG's construction of a new 33kV GIS substation to address asset health, operational, and safety challenges, this option offers a viable route for the reconnection of NGET's transformer to the NPG's new substation.

Following initial optioneering assessment, NGET identified Options D-1 and D-2 as the most suitable options and took them forward to the detailed options assessment and as described above we also developed a third Option during detailed assessment (D-3).

[2] SGT3 and SGT4 are adjacent to the new 33kV GIS substation and therefore do not require routing considerations.

Development and introduction of Option D-3

As our design development progressed, an additional option was introduced as a hybrid of the two options. This additional option was introduced primarily due to identification of the need for adequate phase separation between the cable to ensure there is minimal/no thermal interference that will restrict the cables from establishing the desired 120MVA rating. There were therefore 3 options considered altogether as part of our detailed options analysis, as described in section 4.2.

4.2 Description of all options

The three shortlisted options differ from each other in terms of the SGT1 and STG2 cable connection routes, and accordingly the associated civil/excavation works that would be required to develop the routes. Chapter 4 concludes by setting out our preferred option.

Option D-1 is illustrated via the red route in Figure 5 below, and Option D-2 is illustrated via the amber route. Option D-3 can be taken as a hybrid of the two options, with the cable for SGT1 taking the amber route and the cable for SGT2 taking the red route. See the illustration provided further below in Figure 6.

4.2.1 Option D-1: North site access road cable routing

Cable Route: SGT1 and SGT2 connect to the new 33kV GIS substation via the north access road; SGT3 and SGT4 connect directly due to proximity.

Cable Length: Approximately 0.64km in installation length.

Civil Works: Excavation and cable trough installation along the north route.

4.2.2 Option D-2: South site access road cable routing – behind the control building

Cable Route: SGT1 and SGT2 connect via the south access road behind the control building; SGT3 and SGT4 connect directly.

Cable Length: Approximately 0.80km in installation length.

Civil works: includes bank reinforcement and retaining walls to avoid interference with existing cables.

4.2.3 Option D-3: Hybrid (North and South access roads cable routing) – in front of control building

Cable Route: SGT1 connects via the south access road in front of the control building; SGT2 connects via the north access road; SGT3 and SGT4 connect directly.

Cable Length: Approximately 0.70km in installation length.

Civil Works: Combines elements of D-1 and D-2, using both routes for optimal configuration. This option avoids the more complex civil works associated with connecting the cables behind the control room building.

4.2.4 Common Works Across All Options

USB Works: Installation of new 33kV SGT bays for all four transformers, including busbar disconnectors, circuit breakers, current transformers, and earth switches.

P&C Works: All options include the same electrical and protection system upgrades to ensure integration and commissioning.

4.3 Qualitative options analysis

Table 5 below provides a summary of our detailed qualitative assessment of the relevant technical, environmental, planning, and socio-economic considerations pertaining to the three options.

Table 5: Summary of qualitative analysis of shortlisted options

Option #	D-1	D-2	D-3
Option title	**North side cabling routing**	**South side cable routing, behind control building**	**North and south side cable routing, in front of control building**
Routing complexity Preferred option: D-1	SGT1 and SGT2 cables routed along the north side of the substation, utilising the north access road. Several utility crossings and two 275kV oil-filled cable circuits along the route which may necessitate some excavation work to avoid.	SGT1 and SGT 2 cables routed along the south side of the substation, behind the control building to avoid interfering with SGT 4 cables, low voltage (LV) services and drainage utilities, therefore requiring excavation on steep slopes.	SGT1 routed along the south side in front of the control building, and SGT2 routed along the north side to split the circuits. Both routes involve utility crossings and 275kv oil-filled cable circuits. Excavation is required to avoid interfering with utilities.
H&S Safety Risk Preferred option: D-1	The route is generally flat with no steep slopes, resulting in a lower safety risk for construction activities.	Steep slopes behind the control building present safety risks for construction, including hazards for workers and equipment.	The north route is flat and safe, while the south route requires careful excavation under services to minimise safety risks.
Civil works: construction Preferred option: D-1	Civil works are relatively straightforward, requiring minimal excavation and installation of cable troughs along a flat route.	Complex civil works are required due to the steep gradient behind the control building, including reinforcement and retaining walls.	Moderate complexity, as excavation is required under the existing services on the south route but avoids the slope challenges of D-2.
System Outages: outages Preferred option: N/A	Proximity outages may be required for Norton Lees and Neepsend 275 kV oil filled cable circuits.	May require proximity outages because of the cabling works for SGT1 and SGT2 being in close proximity to live equipment. May also require proximity outage for crossing existing Wincobank 275 kV oil filled cable circuit.	Proximity may be outages required due live equipment and existing 275 kV oil filled cable circuits.

Option #	D-1	D-2	D-3
Option title	**North side cabling routing**	**South side cable routing, behind control building**	**North and south side cable routing, in front of control building**
Space constraints Preferred Option: D-3	Space is highly constrained along the north route, with insufficient room for all circuits to maintain phase separation.	Space is available along the south route, but using a single path for all circuits increases construction complexity.	Space is optimised by splitting circuits, ensuring adequate phase separation and avoiding overcrowding on any single route.
Technical Performance: Phase Separation Preferred Option: D-3	• Insufficient space to maintain the required phase separation between cables under the existing troughs on the north access road. • Thermal performance is compromised by insufficient phase separation along the north route, leading to overheating risks. • This also can compromise ability to achieve desired 120 MVA rating.	• Adequate space for phase separation is available, but the longer route increases complexity and costs. No/minimum thermal interference between cables. • Adequate thermal performance due to proper phase separation, but at higher cost and with a longer installation timeline.	• Phase separation is maintained on both routes, with sufficient space provided by splitting circuits across north and south paths. No/minimum thermal interference between cables. • Meets thermal performance requirements with balanced phase separation on both routes, ensuring reliability.
Capital cost Preferred Option: D-1	Lowest capital cost due to shorter cable lengths and relatively straightforward civil works.	Highest capital cost due to the longer cable route, steep slopes, and complex civil works.	Higher than D-1 due to additional excavation but lower than D-2, as steep slope works are avoided.
Environment & sustainability Preferred Option:D-1, D-3	Minimal environmental disruption as the route primarily follows existing infrastructure paths.	Environmental disruption is moderate, with potential vegetation removal required behind the control building.	Minimal environmental disruption, as the hybrid route avoids significant vegetation removal and steep slope reinforcements.
Timing of programme	Expected to have the shortest timeline due to simple civil works and shorter cable lengths.	Likely the longest programme due to complex civil works	Moderate timeline: longer than D-1 due to south route excavation but shorter than D-2 by avoiding slope-related challenges.

Option #	D-1	D-2	D-3
Option title	North side cabling routing	South side cable routing, behind control building	North and south side cable routing, in front of control building
Preferred Option: D-1, D-3			

Based on the qualitative data above, we discounted Option D-2 as the least preferred option for reconnection of the SGT1 and SGT2 to the new 33kV GIS substation. The terrain behind the control building features steep slopes, introducing health and safety risks for workers during construction. Additionally, the steep slopes would require significant reinforcement and retaining wall construction to stabilise the area for cable installation. This added substantial complexity and cost to the project, making it the most expensive option among all three. The additional civil works required for slope reinforcement meant that Option D-2 would have the longest timeline for deliver.

Option D-1, which routed all cables along the north access road, initially appeared to be a straightforward and cost-effective solution. However, as the design evolved, key technical and operational limitations emerged:

- Detailed design revealed that the north access road lacked sufficient space under the existing cable troughs to maintain the required phase separation for SGT1-3 cables. This limitation compromised thermal management, increasing the risk of cable overheating and reducing the cables' operational lifespan.
- The inability to maintain adequate phase separation along the north route is critical for ensuring the 120 MVA load rating for SGT1 and SGT2.

Option D-3 emerged as the optimal solution by splitting the circuits across two routes, addressing the key issues identified in both D-1 and D-2:

- By routing SGT1 along the south (in front of the control building) and SGT2 along the north, D-3 ensured sufficient space for phase separation and proper thermal management, avoiding overheating risks.
- While D-3 requires careful excavation under existing SGT4 cables in front of the control building, it avoids the extensive slope reinforcement and retaining walls required if going behind the control building as described for Option D-2. This made it a more balanced option in terms of construction complexity and cost to consumers.

4.4 Quantitative options analysis

4.4.1 Lifetime Cost-Benefit analysis (CBA)

The CBA was carried out using the NGET CBA/NPV (net present value) tool which is based on Ofgem RIIO-T2 CBA template spreadsheet, assuming a capitalisation rate of 85% and a pre-tax (weighted average cost of capital) WACC of 3.27%, in line with Ofgem's guidelines.

A summary of the lifetime CBA results is presented in the table below. Costs and benefits are discounted at a rate of 3.5% for the first thirty years, and at 3% after that, in line with Ofgem guidance. Costs and benefits are presented relative to a 'do minimum counterfactual.

The results shown in the table below demonstrate that option D-1 has a more favourable NPV in comparison to D-2 or D-3.

Table 6: Lifetime Cost-Benefit analysis (discounted 2018/19 prices)

Options	Total (£m)			
	Costs (discounted)	Benefits (discounted)	NPV	Difference to baseline
D-1	[redacted]			
D-2				
D-3				

4.4.2 Costs

4.4.2.1 Capex costs

All CAPEX cost estimates are derived from the NGET Project Development Cost Book (August 2024 with 2018/19 prices), which is based on historical tender returns and project data. The cost estimations are based on pre-tender award estimates and are subject to change based on actual tendered solutions. The illustrated options are assessed against a "do something" counterfactual.

We have used Estimating Units Lines (EULs) to generate cost estimates based on the scope of work and the new assets to be constructed for each option, including risk contingency.

Table 7: Summary of costs (undiscounted 2018/19 prices)

Option	Total CAPEX (£m)	Carbon cost of construction (£m)	Total (£m)
D-1	[redacted]		
D-2			
D-3			

The difference within the CAPEX cost can be accounted for by the difference in scope between the three options. The investment involves the replacement of the ageing shared 33kV switchgear.

Future replacements cost of new assets

To assess the costs of the investment, future replacement costs of the new assets were included within the CBA. It has been assumed that the assets on average would have a lifespan of 40 years after the first year of construction. With initial construction commencing in 2025, the replacement costs will commence in 2065. It has also been assumed that the replacement cost would mirror the absolute cost and timespan occurred in the initial construction. The replacement costs will also impact the carbon cost of construction. In line with Ofgem guidance, the CBA spans 50 years commencing 2023. As both the construction and replacement occur within the 50-year appraisal, the replacement cost has been taken into account within the assessment.

Table 8: Summary of replacement costs (undiscounted 2018/19 prices)

Option	Replacement spend profile (£m)	Carbon cost of construction (£m)	Total (£m)
D-1	[redacted]		
D-2			
D-3			

4.4.2.2 OPEX costs

Annual maintenance costs [applies to no option]

Given that the maintenance costs do not differ amongst options, and that estimation of these costs would be heavily assumption-driven, annual maintenance costs have been excluded from the CBA.

Constraint costs

No data has been investigated and produced for the current stage within the proposal and therefore constraint costs have been excluded from the assessment for all options.

4.4.2.3 Summary of costs

A summary of the costs within the assessment is illustrated within the following table:

Table 9: Cost summary £m (undiscounted 2018/19 prices)

Option	Initial cost (£m)	Replacement cost (£m)	Total cost (£m)
D-1	[redacted]		
D-2			
D-3			

4.4.3 Benefits

Avoided carbon cost of generation

This proposal suggests no generation connections and therefore there is no benefit from avoid carbon cost of generation.

Table 10: Avoided carbon cost of generation (undiscounted 2018/19 prices)

Option	Avoided carbon cost of generation (£m)
D-1	[redacted]
D-2	
D-3	

SF_6 – leakages[3]

No SF_6 leakage data was identified and therefore not included within the assessment.

G^3 – leakages

Upon operation gas leaks will be unavoidable. The disbenefit of these leaks is accounted for by the monetisation of the economic value of 1kg of CO_2 emissions. The disbenefit was quantified by the

[3] Further to development on the project and review of the market, it was noted that No Non SF6 options were available to NPG and as such technical design was processed to use SF6.

multiplication of the total non-SF6 weight by 0.5% which captures the leakage and disbenefit to society. The value was divided by a thousand and multiplied by the 326 which represents the equivalent of G^3 weight into CO_2. The equivalent CO_2 weight is multiplied by the carbon price to calculate the disbenefit. *Table 11* below illustrates the non-SF6 disbenefits for the analysis. In addition, the value of gas loss was calculated by multiplying the annual MWH loss with the GHG reduction factor divided by a million. This was then multiplied by the cost per unit of MWh loss. The addition of the gas and CO2 equivalent loss created the disbenefit presented below.

Table 11: Gas leak disbenefit (undiscounted 2018/19 prices)

Option	SF_6 emissions (kg)	G^3 emissions (kg)	Gas emissions (tCO_2e)	Economic value of the benefit (£m)
D-1	[redacted]			
D-2				
D-3				

Transmission losses

Transmission losses occur when energy is lost in equipment due to forces such as friction which turn the electricity into heat. Within the assessment the loss of electricity has been accounted for as a disbenefit to society as the lost electricity that could have been utilised.

The disbenefit is calculated utilising the transmission loss estimates from the cost book for each option. The loss is assumed to occur during and after the ACL for 40 years as explained in the template. The total estimation is divided by the 30 years to obtain an annual disbenefit. The value is then divided by the total losses to understand the transmission loss as a proportion of the total loss. The yearly loss is then divided by the electricity GHG conversion factor (tonnes per MWh) to calculate the annual MWh loss per year across the lifespan.

The value is converted into tCO_2 equivalent utilising the electricity GHG conversion factor. The value of the disbenefit is then multiplied by the traded carbon price to obtain a quantified value.

The outputs are illustrated in the table below:

Table 12: Transmission losses (undiscounted 2018/19 prices)

Option	Total MWh loss	Emissions associated with losses (tCO_2e)	Value of loss (£m)
D-1	[redacted]		
D-2			
D-3			

4.4.3.1 Summary of benefits

A summary of benefits included in the analysis is illustrated in the following table:

Table 13: Benefits summary (undiscounted 2018/19 prices)

Option	Environmental benefits			Total benefits (£m)
	Carbon cost of construction (£m)	Gas leak (£m)	Transmission loss (£m)	
D-1	[redacted]			
D-2				
D-3				

4.5 Preferred solution

Cable Replacement and Routing

Based on the qualitative and quantitative analysis we have selected Option D-3 as the cable routing solution that presents the value to consumers for meeting this investment driver.

Despite a marginally lower NPV, Option D-3 was selected because it offered the most technically feasible and operationally reliable solution. While D-1 had a marginally better NPV, it failed to meet phase separation and thermal management requirements, compromising cable performance. D-2, with the lowest NPV, involved excessive costs and risks due to slope reinforcement. D-3 effectively balanced cost to consumers and technical constraints making it the most justifiable choice.

This hybrid approach of D-3 splits the circuits, routing SGT1 along the south side in front of the control building and SGT2 along the north side. This solution ensures adequate phase separation to minimise thermal interference and achieve the required 120MVA rating required for the new cables. We consider that it is a balanced and practical and solution for this investment driver.

The additional cables for SGT3 and SGT4 did not require an optioneering assessment, due to the proximity of the SGTs to the new substation location, as illustrated in Figure 6 below. The total cable length for all SGT cables are approximately 0.7km. Associated civil works will include excavation along the cable route and the installation of cable troughs to support the new cables.

User Self-Build (USB) Connection Works

- Installation of new 33kV SGT bays for each transformer (SGT1–SGT4).
- Each bay will include the installation of busbar disconnectors, circuit breakers, current transformers, and earth switches to enable safe and efficient operation.

Protection and Control (P&C) Works

- Modification and/or replacement of the 33kV SGT bay protection systems to accommodate the new cable connections and equipment.
- Database updates and associated software changes required for the successful installation and commissioning of the new 33kV SGT bays. When SGT bays are installed as part of the substation upgrade, database changes are essential to ensure that the new infrastructure is properly integrated into the operational, protection, and control systems. These changes are critical for real-time monitoring, control, and fault response.

This proposed scope of work ensures reliable integration of NGET's transformers to NPG's new 33kV GIS substation at Pitsmoor substation.

5. Detailed cost for preferred solution

5.1 Introduction

This section provides a breakdown of the overall costs for the NPG driven asset replacement scheme at Pitsmoor, including an expenditure profile for all Regulatory Years of delivery. The following cost estimate breakdown represents our latest view of costs for the proposed investment and all costs are presented in 2018/19 price base, unless otherwise stated.

The Contractor's quotation return for the delivery works associated with the Pitsmoor project are due to be received in [redacted] therefore initial costs included within this MSIP submission are internal estimates only at this stage, based on the defined scope as detailed within the direct allocation documentation.

Upon completion of the procurement process and agreeing final contractor costs, NGET will subsequently provide an updated cost submission for this MSIP Re-opener. This submission will detail the market tested pricing received as part of the procurement exercise and request full funding allowances for the scheme.

Appendix I Cost Model submitted alongside this document provides a breakdown of the costs in more detail and should be reviewed alongside this chapter.

This Chapter is broken down into the following sections:

- Total Allowance Request
- Cost Estimate
- Cost Firmness

5.2 Total Allowance Request

Total project costs are [redacted] NGET requests [redacted] allowance is provided through the MSIP reopener mechanism to recover the direct portion of costs and deliver works described above. The MSIP reopener mechanism is subject to the Opex escalator and therefore indirect costs will be funded under this route.

Table 14: Allowance request

£	2023/24	2024/25	2025/26	2026/27	2027/28	2028/29	Total (£)
[redacted]							

5.3 Cost Estimate

The total cost to develop and deliver the Pitsmoor asset replacement project is currently estimated at [redacted] including indirect costs and costs incurred to date. These costs are our best estimates based on E-hub.

Table 15 below shows a summary of total project costs

Table 15: E-Hub Cost Estimates

Element	Total £ (2018/19 price base)	Classification
Contractor Costs	[redacted]	
Main Works Contractor		Direct
Third Party Costs		CAI
National Grid Costs		

Project Management	[redacted]	Direct
ET Ops		CAI
Project Services		CAI
Support Functions		CAI
NGET Portfolio Costs		CAI
Other Contracted Costs		
RPE's		Direct
Risk		Direct
Total		

5.4 Cost Firmness

Table 16 below shows the assessment of cost firmness using the classification outlined in the Ofgem LOTI reopener guidance document published on 29th March 2021. This shows that the majority of the total costs have been estimated, as we expect to complete the tendering of contract for the project by [redacted] (refer to Table 17 in the Deliverability and Risk section below).

Table 16: Cost Firmness

Cost Firmness	Total (£)	Notes
1 - Fixed	[redacted]	Prior costs and 2024/25 actuals
2 - Agreed remeasurable		
3 - Agreed remeasurable future information		Third Party
4 - Estimated		Contractor, contract Inflation, risk, NG costs, portfolio costs (less actuals)
5 - Early Estimate		
Total		

Estimated costs relate to National Grid resource costs, calculated based on forecast days and standard rates, as well as risk for the remainder of the project.

6. Deliverability and risk

6.1 Deliverability

This section sets out a summary of the key activities pertaining to the delivery of the project, including the current high-level programme plan, procurement strategy and anticipated risks.

6.1.1 Delivery Programme

A detailed project delivery timeline has been prepared by NGET. This plan facilitates the customer's contracted connection date of [redacted]

The key project milestones are summarised below:

Table 17: Outline of the key project milestones

Milestone	Date
FEED Design Complete	[redacted]
Sanction (Internal)	
Contract Award	
First Site Access	
SGT 1 Outage	
SGT 2 Outage	
SGT 3 Outage	
SGT 4 Outage	
Available for Commercial Load SGT1	
Available for Commercial Load SGT2	
Available for Commercial Load SGT3	
Available for Commercial Load SGT4	
Completion	

NGET are currently on track to meet a [redacted] contract award date, having completed feed design in [redacted]

6.1.2 NGET Procurement - Supply Chain Task Force

The primary objective of the procurement and contracting strategy for this investment is the delivery of a high quality project outcome satisfied in the most economic and efficient manner in accordance and compliance with the Utilities Contract Regulations (UCR). The strategy considers the unique, innovative, and remote locational factors of this project, whilst ensuring an efficient outcome for all contract costs. Finally, the strategy takes cognisance of any pre-existing and future supply chain constraints, will assess methods to obtain maximum value for customers and will foster the most appropriate allocation of risk considering different contracts and construction delivery models.

NGET have recently seen the relative attractiveness of competitive tenders for work across the Substation Construction Category Area be impacted by the sharp increases in both the volume and scale of construction and infrastructure projects available in the UK and overseas. Consequently, there is a major skills shortage in key aspects of the supply chain's labour profile required to resource

a Substation Project, meaning the Procurement Team must think differently moving forwards and must act in a more agile way when responding to these market constraints and creating contracting strategies. As such, NGET has created an internal working group called the Supply Chain Taskforce, who's remit is to collate all internal NGET Workbook demand across business units, and (where a main works contractor is required) bulk allocate these projects to our framework contracting partners, to leverage the value of our spend whilst encouraging suppliers to invest in their localised teams by committing up-front.

6.1.3 Procurement and Contracting Strategy

In terms of what this means for this project, the taskforce have grouped this scheme into 'Wave 2 – Value Proposition', which categorises this scheme (and over 40 others) as in need of supply chain engagement within FY24-25. A supplier allocation will be chosen by the Taskforce from the full selection of EPC and M&E Framework Contractors on the basis of the Best for Task Criteria outlined in Schedule 2 of the Framework Agreement – this will take into account site presence and expertise, locational advantages, resource availability and technical competency, as well as contractor preference waited in a scorecard.

The Taskforce is also responsible for establishing a contract strategy. In this instance, an NEC4 Option C Detailed Design & Build contract was chosen as the most appropriate form of contract for this scheme, given that full Design Development has already been undertaken. Gain Share will be included within the contract with suggested cap and collars between 85% and 115%. There will be a 50%/50% share between cap and collars, that is allowed for within the risk pot. This scope of works will allow for a detailed assessment of the supplier's bid on an activity-by-activity basis through submission of an Activity Pricing Schedule (APS) that will form the budget for the works. The Contractor will submit monthly payment applications for work done to date

6.1.4 Risk and Risk Management

A risk management process has been used for managing reasonably foreseeable risks. The process employed is in line with ISO 31000:2009, Risk Management – Principles and Guidelines.

Table 18 below lists the key risks identified for the project.

Table 18: Delivery risks for Pitsmoor 275kv Asset Replacement

Risks	Mitigation
Planned Outage (Cancellation / Amendment) Safety incidents, unforeseen events, or changes in outage plans may result in contractor downtime or delays.	Outages are planned and requested based on dates defined in Table 11 to ensure alignment and avoid disruptions.
Costs Uncertainty in contractor quantities and quotes could increase final costs or alter project base estimates.	Engage the E-hub estimating team to forecast contractor costs using data from previous projects and agreed contractor framework rates.
Protection and Control [redacted]	Design review meetings to be ongoing to coordinate Design requirements
Interface between Cable and Substation Work Packages Delays or misalignment between cable and substation work packages could impact the programme schedule and increase costs	Maintain ongoing stakeholder coordination between User works, USB works, AO Works and NGET Scope of works.
Unidentified Buried Services	GPR survey completed. Safe digging techniques (HSG47) to be enacted.

Deep excavation may uncover unidentified buried services, causing damage, removal or repair costs, and potential redesigns or delays.	
Ground Contamination Unforeseen ground conditions could result in costly improvements, disposal of hazardous materials, and project delays. Ground investigation surveys are yet to be undertaken on site. Historical evidence however indicates favourable ground conditions.	Surveys to take place as part of contract of works. Ongoing monitoring to take place.

7. Conclusion

This document is NGET's MSIP re-opener submission to Ofgem for the Pitsmoor 275kV asset replacement and reconnection project. It is submitted with reference to Special Condition 3.14 of NGET's Transmission Licence. Following Ofgem's approval of our DNO customer's (NPG) Pitsmoor rebuild under RIIO-ED2, this submission outlines NGET's necessary works to integrate the assets on site. The proposed solution has been designed to deliver these works in the most efficient and cost-effective way for consumers, and in line with Special Condition 3.14 of NGET's Transmission Licence.

Table 19 below summarises the main investment driver, the selected option, estimated costs and expected outputs.

Table 19: Pitsmoor 275/33kV Investment Summary

<table>
<tr><td>Main drivers</td><td colspan="3">Northern Powergrid requires the replacement of all of their 33kV circuit breakers on the 1/2 and 3/4 boards at Pitsmoor 33kV with new indoor switchgear. This work will necessitate the replacement of the NGET SGT low voltage circuit breakers, these will be integrated into the new switchboards. This has driven the NGET scope of cable replacement and various P&C works.</td></tr>
<tr><td>Selected Option</td><td colspan="3">1. Replacement/modification of the existing 33kV SGT cable connections from Pitsmoor 275kV substation to the new NPG 33kV substation via North and South site routes.
2. USB connection works - Installation of new 33kV SGT bays for SGT1, SGT2, SGT3 and SGT4, including busbar disconnectors, circuit breakers, current transformers and earth switches.
3.Modification/replacement of 33kV SGT bay protection system
4. Database changes associated with the installation and commissioning of the new 33kV SGT bays.</td></tr>
<tr><td rowspan="2">Estimated Cost

(18/19 Price Base)</td><td colspan="3">Our total cost for the investment and funding allowance being sought is for:
The current total cost of the project is [redacted]
The total direct cost of the project – the funding this MSIP seeks – is [redacted]</td></tr>
<tr><td>T2 (FY2022 – FY2026):
[redacted]</td><td>T3 (FY 2027 – FY2031):
[redacted]</td><td>T4+ (FY 2032+):</td></tr>
<tr><td>Outputs</td><td colspan="3">Network reliability: The project will replace ageing circuit breakers, circuit protection and cables, ensuring the continued safe and efficient operation of the substation. This upgrade is essential to maintain a seamless connection between NGET's transformers and Northern Powergrid's system. By coordinating these asset updates with Northern Powergrid's substation replacement, the project enhances overall network stability, reduces the risk of failures, and supports long-term reliability for both current and future electricity demand.</td></tr>
<tr><td>PCD Primary Outputs</td><td colspan="3">Replacement and reconnection of cables for STG1-4 to new NPG 33k GIS substation, Installation of new 33kV SGT bays for SGT1-SGT4 & Protection and control related works - Delivery by [redacted]</td></tr>
</table>

Ofgem approved NPG's proposed asset replacement at Pitsmoor via the construction of a new 33kV GIS substation, which requires NGET to replace and reconnect 33kV circuits from its four Super Grid Transformers (SGTs) to NPG's new indoor GIS substation. The development also requires NGET to replace its own 33kV switchgear housed within the shared infrastructure.

NGET's preferred option for the cable routes is the optimal configuration, prioritising the avoidance of thermal interference between the high voltage cables, ensuring system reliability and futureproofing for 120MVA capacity. This delivers an efficient solution for consumers that ensures long-term operational efficiency.

8. RIIO-T1 and RIIO-T2 allowances

There were no investments proposed for both projects during either RIIO-T1 or T2 business plans submissions and so no funding was received. The Projects do not have funding through any other price control mechanism.

9. Assurance and Point of Contact

Attached to this submission is the assurance statement letter, providing written confirmation in line with the assurance requirements set out in Ofgem's Re-opener Guidance and Application Requirements Document, dated 17th February 2023.

This confirmation is provided by the Head of Future Price Controls, Electricity Transmission. They provide the following statements below regarding how this MSIP application has been prepared and submitted in relation to each of the three assurance points requested by Ofgem:

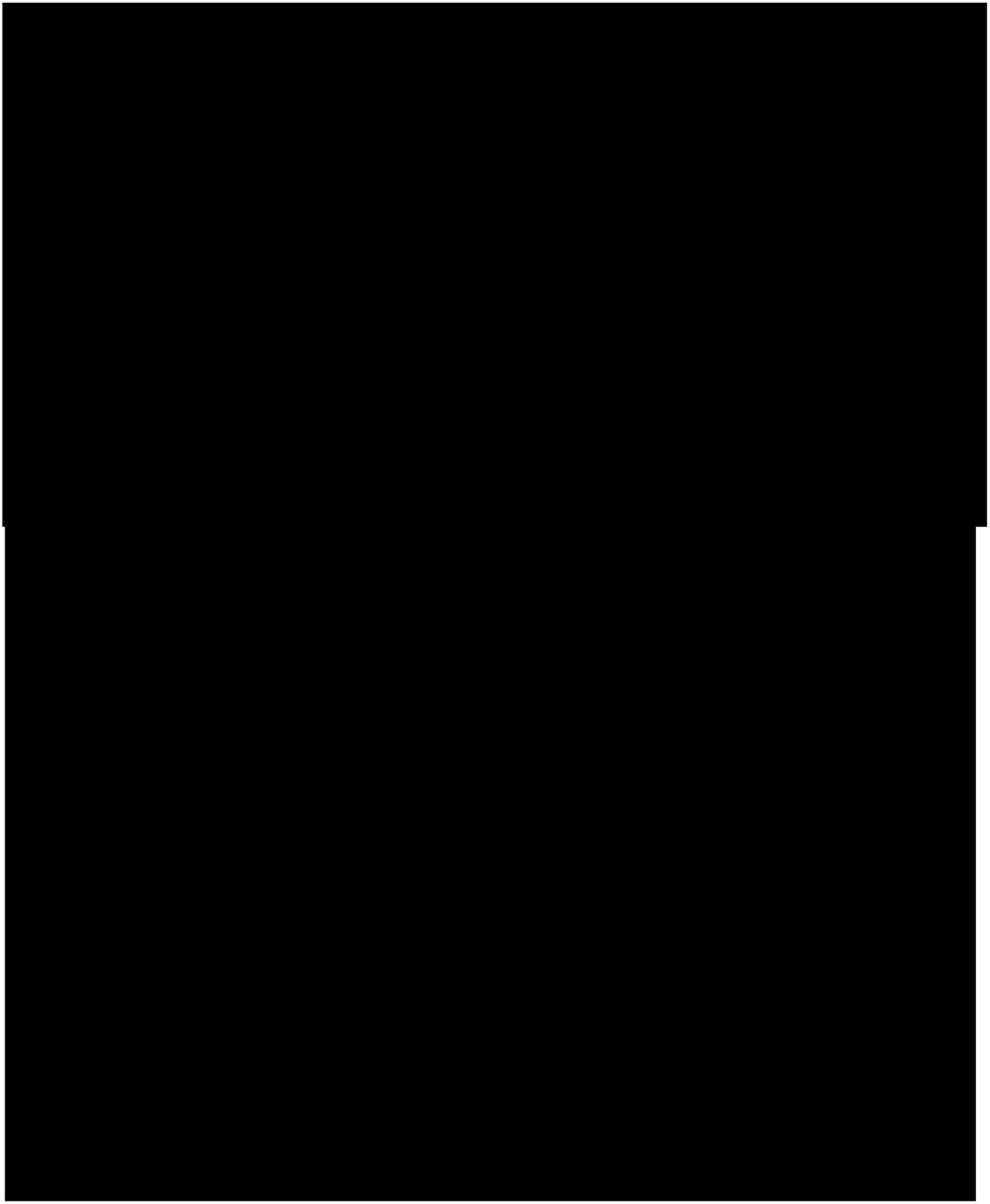
a. It is accurate and robust, and that the proposed outcomes of the MSIP submission are financeable and represent best value for consumers.

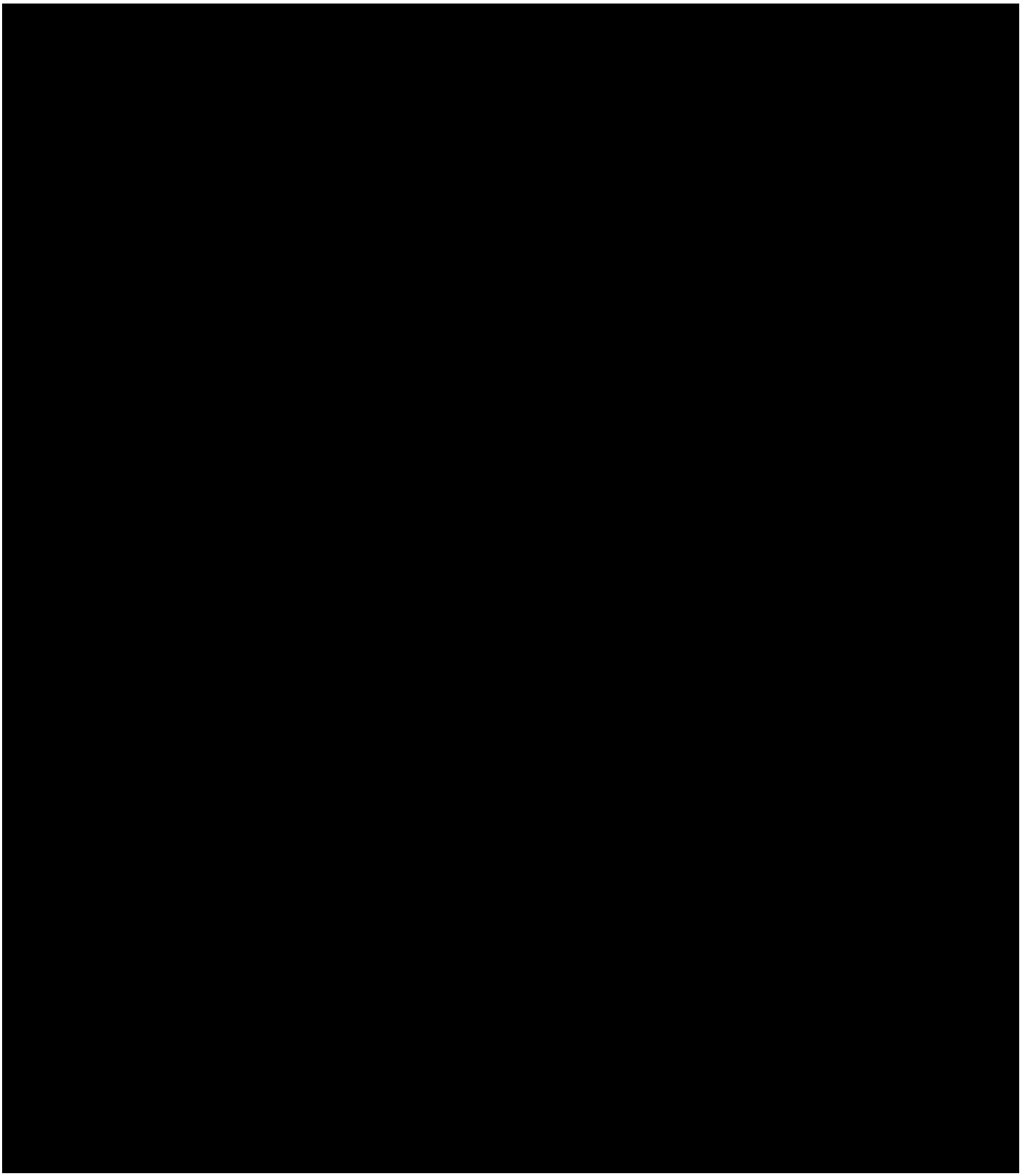
b. There are quality assurance processes in place to ensure the licensee has provided high-quality information to enable Ofgem to make decisions which are in the interests of consumers.

c. The application has been subject to internal governance arrangements and received sign off at an appropriate level within the licensee.

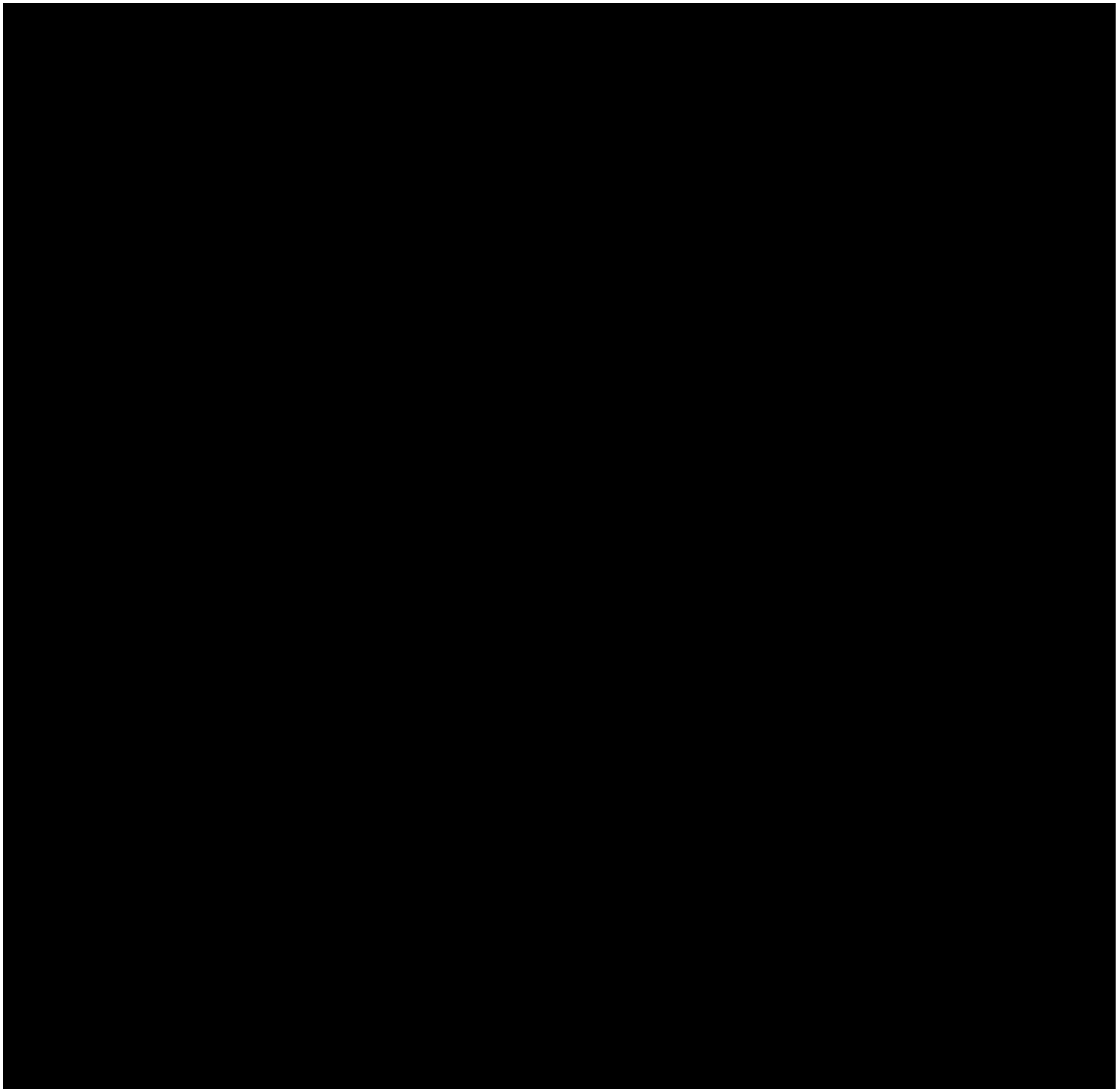
NGET's designated point of contact for this MSIP application is Leo Michelmore, Strategic Upgrade Regulatory Manager (leo.michelmore@nationalgrid.com).

Appendices





[4] The fault current or inrush current experienced at the Pitsmoor 3/4 connection point is greater than what the existing circuit breakers are rated to safely handle. This means the breakers could fail to close properly, or if they do, they might not withstand the stress.



Appendix D: Pitsmoor Substation - web map

Appendix E: Stakeholder Engagement

The associated scope of works for the 33kV Switchgear replacement project for NGET is confined within the land owned by NGET, and as such, minimal interaction with external stakeholders is expected during the project. The primary stakeholders associated with the project include National Grid Asset Operations (Site occupier and ongoing maintenance and Asset replacement works projects) and Northern Powergrid (Customer).

Throughout the development of the project to date, both NG Asset operations and NPG have been included in updates and consultations of the design development of the project, including during the optioneering phase. Input and feedback have been incorporated into the philosophy of the project from both stakeholders and this has been captured during monthly interface and design review meetings. This has ensured that the chosen option D-3 has been coordinated and agreed with both stakeholders.

A high-level summary of the engagements so far includes:

Monthly Interface Meetings with NPG: Liaison with NPG on project progress and design specifics to ensure project works are aligned and progress to programme. These meetings also include updates from the Customers Principal Contractor associated with the User scope of works.

Internal Interfacing Projects: Monthly meetings with internal NG Asset Operations teams. Asset Operations teams have ongoing projects in development that will be in delivery site during the same period as the 33kV Switchgear replacement project. Health & Safety, outages and key work areas will be coordinated between parties as work progresses from development.

Local Community Engagement: As the project progresses, local businesses and stakeholders will be informed of significant site activities, such as high-voltage (HV) cable deliveries, to avoid disruptions to site access. This is an ongoing interface in relation to the Pitsmoor site and any work that is completed on site and will be aided by the Site Occupier NG Asset Operations.

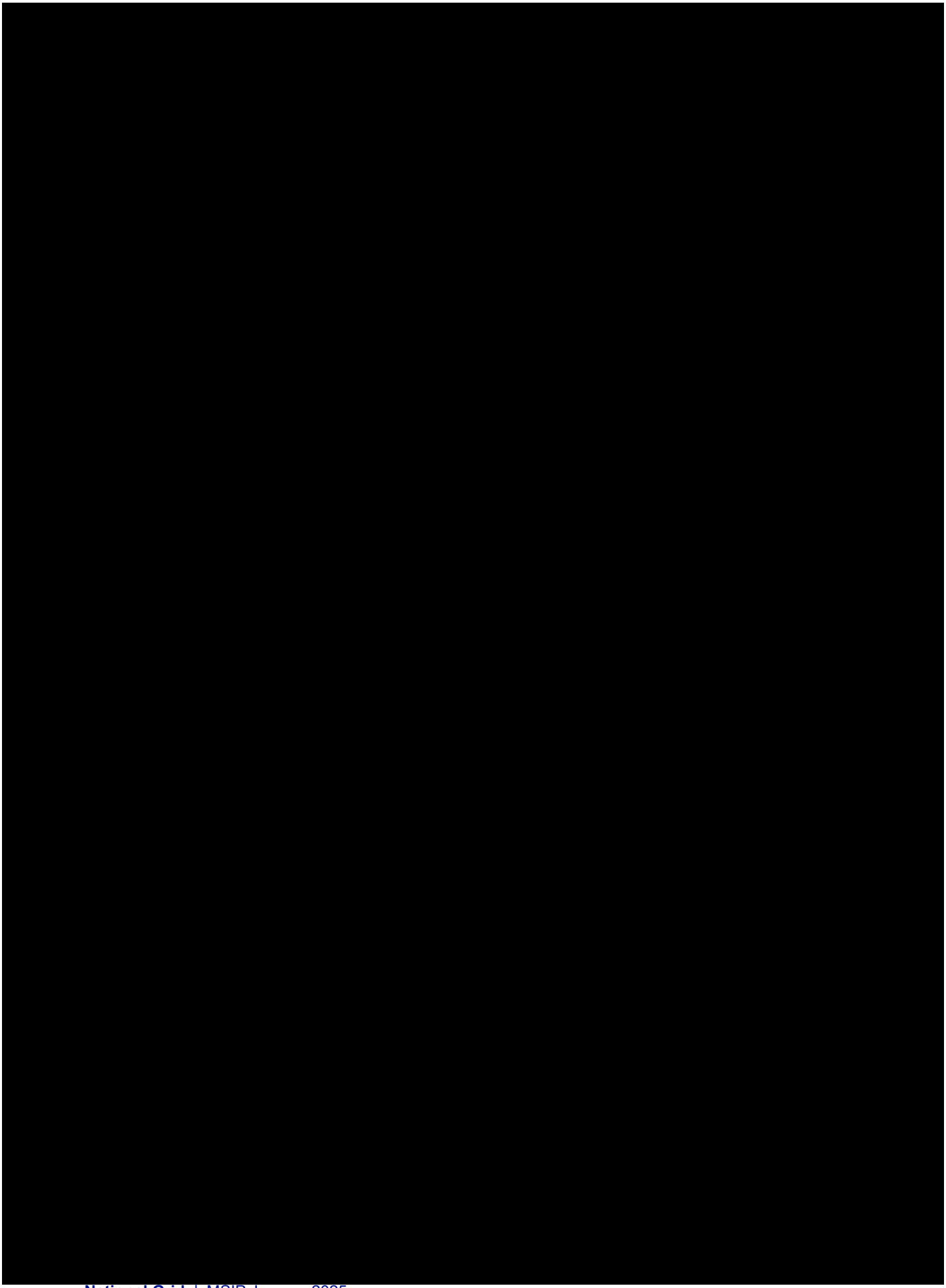
Outage planning: Liaison with the outage planning team and NESO to coordinate outage requirements for the project and manage risk of cancellation or schedule changes.

Ongoing Engagement and Feedback: Any feedback or actions from these meetings will be considered and actioned accordingly by the project team as the project continues through into delivery. This approach ensures alignment between stakeholders, minimises risks, and supports successful project execution.

Appendix G: Volume Driver to Total Cost

An excel file demonstrating different between total volume driver allowances the investment is eligible for, compared to total efficient costs is provided alongside this submission attached with title Pitsmoor Volume Driver Variance.

'Appendix G - Pitsmoor Volume Driver Variance Calculator – MSIP Jan25'



Appendix I: Cost Model

Please see the accompanying Cost Model submitted alongside this MSIP.

'Appendix I.1 - Pitsmoor Cost Model – MSIP Jan25'
'Appendix I.2 – Estimated Inflation – MSIP Jan25'

Appendix J: CBA

Please see the accompanying CBA submitted alongside this MSIP.

'Appendix J - Pitsmoor CBA – MSIP Jan25'

Appendix K: Glossary

Acronym	Definition
NGET	National Grid Electricity Transmission
NESO	National Electricity System Operator
NPG	Northern Powergrid
SGT	Super Grid Transformer
GIS	Gas Insulated Switchgear
MSIP	Medium Size Investment Project
RIIO-ED2	Revenue = Incentives + Innovation + Outputs - Electricity Distribution
LVAC	Low Voltage Alternating Current
PCD	Price Control Deliverable6
USB	User Self-Build

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