Re-opener Report

January 2023 MSIP Need Case submission

Projects:

- Stocksbridge 400kV substation
- Bradford West 275kV substation
- Stalybridge 400kV substation

nationalgrid

1. Executive Summary

1.1. This submission requests the approval by Ofgem of the Need Case for the additional allowances to provide new shunt reactors connected to the following National Grid Electricity Transmission's (NGET) sites: -

- Stocksbridge 400kV substation – 200 MVar Unit
- Bradford West 275kV substation – 100 MVar Unit
- Stalybridge 400kV substation – 200 MVar Unit

1.2. NGET have been awarded the development, design and delivery works as an output from NGESO's Network Options Assessment (NOA) High Voltage Pathfinder. The assets being connected will be providing reactive compensation only and are not directly associated with customer connections. Funding will therefore be requested under clause 3.14.6 (f) of the Medium Sized Investment Project (MSIP) reopener mechanism.

1.3. The preferred connection solutions, to minimise cost to the consumer, minimise environmental impact and achieve the desired connection dates, are: -

- Use an existing plinth and bunded area at Mesh Corner 2 of Stocksbridge 400kV substation
- Build a new plinth and bunded area connection at Mesh Corner 1 of Bradford West 275kV substation
- Build a new plinth and bunded area connection at Mesh Corner 1 of Stalybridge 400kV substation

1.4. The "do nothing" option was considered but did not satisfy the need. The other mesh corners at each of the sites were considered as options but were rejected due to the preferred options being more favourable in terms of: -

- Available working space and proximity to nearby buildings/assets at Stocksbridge
- Other known connection requirements and future bay allocations at Bradford West
- Available working space and the required network connection position at Stalybridge

1.5. The options to provide the preferred connection solutions offer the lowest costs and earliest connection dates. The chosen connection options satisfy the technical requirements of NGESO. The solutions are based on providing NGESO with the agreed "counterfactual" baseline only, and do not include any wider network or site improvements.

1.6. The proposed in-service delivery date is April 2024, and all spend will be within the RIIO-T2 period. The connection dates required by NGESO are relatively soon for a project of this type and we have therefore had to accelerate our activities to make significant progress in order to meet the required in-service dates. As such the optioneering and development stages are compressed into relatively short timescales.

1.7. The funding requested will be xxxxxxxx in 18/19 price base and costs have been incurred already for activities such as front-end engineering (FEED) and ordering the shunt reactor units themselves. To align with the in-service delivery date, the three projects will require to be developed at pace, incurring costs as each project progresses whilst Ofgem assesses the need case and subsequently later the cost breakdown. Due to the MSIP Materiality Threshold, the cost breakdown will not be provided within this submission and will be provided via a cost submission in the future.

2. Introduction

1.8. This document is the formal MSIP Pathfinder Need Case submission to Ofgem by NGET relating to the NOA High Voltage Pathfinder in the Pennine region. This is submitted under the MSIP re-opener provided for in Special Condition 3.14 of the NGET Transmission Licence.

1.9. The MSIP re-opener was introduced by Ofgem to allow Transmission Owners (TOs) to apply for funding for investments under £100m in the network not included in baseline funding. TO's MSIP submissions allow for Ofgem to carry out an assessment of the need and cost of the proposed investment.

1.10. This submission is made in accordance with the 'RIIO-2 Re-opener Guidance and Applications Requirements' published by Ofgem in February 2021. The contents of the submission have also been informed by engagement between NGET and Ofgem with the aim of ensuring that this submission enables the Authority to make a positive timely decision on funding.

1.11. NGET have evidenced that the proposed investment represents the lowest cost option for consumers and is the only feasible connection option that can facilitate the customer's desired connection date. The provision of comparison of capital costs of options will be provided via a cost submission in the future, it is not our intention to include a detailed Cost Benefit Analysis (CBA). It is our view that a CBA is not required in order to make an informed investment decision and as such one has not been provided.

1.12. The works described in this submission are required to provide connections for an additional 500 MVAr reactive power control across three sites in the West Yorkshire area. The three reactor solutions are listed below along with a map showing the site locations:

- Stocksbridge 400kV substation – 200 MVar Unit
- Bradford West 275kV substation – 100 MVar Unit
- Stalybridge 400kV substation – 200 MVar Unit

Figure 1: Shunt reactor site locations

1.13. For the three shunt reactors, connection to the National Electricity Transmission System (NETS) is required by April 2024.

3. Structure of the Reopener Submission

The table below signposts the structure of the document and sets out the purpose of each section. This also lists the appendices. We invite Ofgem to consider the proposals set out in this submission and raise queries against anything that may require further clarification.

Chapter	Description
1. Executive Summary	○ A high-level summary of the submission.
2. Introduction	○ High level overview of the project and timing of the submission.
3. Structure of the Reopener Submission	○ Navigation tool.
4. Alignment with Overall Business Strategy and Commitments	○ The strategic context.
5. Demonstration of the needs case	○ Sets out the drivers for the project.
6. Options Analysis	○ Describes the range of options considered.
7. Preferred Option	○ Key assumptions, and sensitivity analysis.
8. Project Delivery	○ Contracting strategy, programme timeline.
9. Risk and Contingencies	○ A description of the risks identified and the risk management strategies.
10. Stakeholder Engagement	○ Details the engagements with customers and other third parties, that have an interest or influence and how that has impacted the project.
11. Overview of assurance and point of contact	○ Assurance statement
12. Appendices	○ Appendix A – Assurance Statement ○ Appendix B – Ofgem Re-opener Guidance Note

Table 1: Structure of the document

4. Alignment with Overall Business Strategy and Commitments

The strategic context

1.14. NGET is required by our licence to provide connections for customers. Our baseline RIIO-T2 business plan included the customer connections we had sufficient understanding of and certainty about at that time. Over the course of a price control period, it is expected that existing customers may change their plans or new customers may apply for connections that can require investment within the price control period. These changes are managed through the agreed uncertainty and reopener mechanisms.

1.15. As part of the transition towards a Net Zero network, National Grid Electricity System Operator (NGESO) are seeking to develop new markets to procure the services required to ensure the GB Transmission System can continue to be operated securely and economically.

1.16. These new markets are being developed through the “Pathfinder” project, run by NGESO, which identify service requirements in specific areas of the network and invite existing and new providers to submit commercial bids to provide these services. NGESO makes recommendations for solutions to move forward either via commercial contracts or regulated arrangements.

1.17. If those solutions are not already connected, or do not already have a connection agreement or offer, they will be required to apply for a new connection. This leads to a situation where new customers apply for a connection seeking very specific connection dates to comply with the terms of the contract offered by NGESO through the Pathfinder process.

1.18. The relevant Transmission Owner (TO) will then seek to determine an economic and efficient connection option for these customers which balances the desire for connection by a specific date (normally as quickly as possible) with the costs that would be borne by consumers of different connection options.

1.19. The system operability framework (SOF) highlighted operability risks expected due to the decline in transmission connected synchronous generation over the next decade and an increasing need to absorb reactive power. As part of the Network Development Roadmap the benefits and practicalities of applying a NOA type approach to the operability aspects of system voltage was explored. The outcome defined the Pathfinders project and is the next step in expanding the opportunity for varied technologies and providers to participate in the assessment of market-based solutions against the network owner options. It seeks solutions which absorb reactive power to manage high volts downwards.

1.20. The works described in this submission is an output of NGESO’s NOA High Voltage Pathfinder - Pennine’s process. The solutions are based on providing NGESO with the agreed “counterfactual” baseline only, and do not include any wider network or site improvements.

5. Demonstration of the Needs Case

1.21. The System Operability Framework (SOF) highlighted operability risks expected due to the decline in transmission connected synchronous generation over the next decade and an increasing need to absorb reactive power. The National Grid Electricity System Operator (NGESO) NOA High Voltage Pathfinder sought to find the most cost-effective way to address high voltage issues on the transmission system.

1.22. This connection was not included in NGET's RIIO-T2 baseline plan because the NOA High Voltage Pathfinder – Pennines was not concluded until February 2022 and hence there was insufficient certainty around the investment requirements to allow the project to be included in the baseline RIIO-T2 investment plan.

1.23. NGET have been awarded the development, design and delivery works as an output from NGESO's Network Options Assessment (NOA) High Voltage Pathfinder. NGESO requested NGET to change its Transmission Investment Plans to provide for and proceed with the delivery of the three successful counterfactual options in the West Yorkshire region in accordance with the planning request and programmes set out in the Tender Outcomes from NGESO which can be found at Pennines Pathfinder updates, National Grid ESO[1].

1.24. The assets being connected will be providing ancillary services only and hence do not align with typical demand or generation connections. As such established Uncertainty Mechanisms (UM) for these investment categories do not apply.

1.25. Connections of this type do not provide output against the typical metrics of Mega Watts (MW) or Megavolt Amperes (MVA). They will not export power in the form of MW as a generator would or import power which is measured in MVA via a super grid transformer (SGT) like a typical demand customer. Hence, neither the demand nor generation UM can be applied as there is no output upon which to calculate the allowance. The primary function is to support system stability through providing reactive power (Megavolt Ampere of reactive power, MVAr) as required by NGESO.

1.26. NGET are therefore seeking allowance for this connection under clause 3.14.6 (f) of the Medium Sized Investment Project (MSIP) reopener mechanism.

[1] https://www.nationalgrideso.com/future-energy/projects/pathfinders/high-voltage/Pennines

6. Options Analysis

Solutions to the Needs Case

1.27. With the counterfactual option agreed as the NGESO's preferred approach, further development of the solution is now underway (NGET) to consider the most cost-effective and efficient way of delivering the project, to maximise the benefit for consumers.

1.28. We have optioneered each of the three sites to determine the optimum positioning of the shunt reactors and their associated HV equipment required to make the connections. We have also developed the strategies for managing project cost and risk.

Stocksbridge

1.29. At Stocksbridge there are two available options for positioning a new shunt reactor. This would include utilising one of the two empty plinths / bunded areas currently occupied by Super Grid Transformers (SGTs) to reduce project delivery costs.

1.30. Option 1 is adjacent to Mesh Corner 2. Option 2 is adjacent to Mesh Corner 1.

Figure 3: Stockbridge options aerial image

1.31. Option 1 has been chosen as it is not in close proximity to the office building and diesel generator. Option 2 has a lack of space around the bunded area to extend the bund should this be required. The two options would each have a similar cost. The Single Line Diagram (SLD) below shows the basic HV electrical arrangement of the site. The proposed new shunt reactor and disconnector are highlighted in orange, connected to mesh corner 2 (MC2).

Figure 4: Stockbridge SLD

Bradford West

1.32. At Bradford West Mesh Corners 3 and 4 are already allocated to future customer connections and are therefore not available. There is also some space adjacent to Mesh Corner 2 which is available but is more difficult to access due to the proximity of existing buildings and HV equipment. Mesh Corner 1 is therefore the preferred connection location. Adjacent to Mesh Corner 1 there are two options for positioning a new shunt reactor, both of which would require the construction of a new plinth and bunded area. Option 1 is in a relatively large space in the northern corner of the site. Option 2 is in a space central to the substation. These are indicated in the image below.

Figure 5: Bradford West options aerial image

1.33. Option 1 has been chosen due to having more space available for HV equipment and easier access. Option 2 would have a more complicated shunt reactor delivery which may require proximity outages. Option 2 is still a feasible option should an alternative option be required. Option 2 would have a slightly higher cost than Option 1, due to the increased risks associated with more difficult access and less available space for the shunt reactor. The Single Line Diagram (SLD) below shows the basic HV electrical arrangement of the site. The proposed new shunt reactor, disconnector and dedicated circuit breaker are highlighted in orange, connected to mesh corner 1 (MC1).

Figure 6: Bradford West SLD

Stalybridge

1.34. Available space within the existing fence line of the Stalybridge 400kV site is limited. There are four options for positioning a new shunt reactor, all of which would require the construction of a new plinth and bunded area. Any proposed layout must allow for a future customer connection in addition to the shunt reactor connection.

Option 1

1.35. Our preferred option is Option 1 and is in the northern corner of the existing site, within the existing fence line, as shown in the image below. This option has been selected to take forward.

Figure 7 Stalybridge option 1 aerial image

Option 2

1.36. Option 2 is a fence line extension and shunt reactor positioning outside of the current site boundary, as shown in the image below. This would require an extension of the substation resulting in ground clearance, ecology surveys and flood defence alterations. It has been rejected on substantial estimated cost increases of additional works required above the scope of works required for Option 1, risk, programme (ecology, planning permission and flood assessment / Environment Agency processes) and complexity (site flood defence alterations).

Option 3

1.37. Option 3 the shunt reactor location is central to the existing site as shown in the image below. There would be a cross-site cable connection between Mesh Corner 1 and the new shunt reactor. It has been rejected on initial cost / complexity of additional cables but remains a feasible option should an alternative option be required.

Figure 9: Stalybridge option 3 aerial image

Option 4

1.38. Option 4 is a shunt reactor position within the adjacent Stalybridge 275kV compound. It involves a 400kV cable interconnector between the two sites, crossing a river and wooded area as shown in the two images below. There are two cable routes considered for interconnecting between the two compounds, hence options 4a and 4b below. This option has been rejected on initial cost estimates, risk, programme / complexity of additional cables required for crossing of river and the ecological impact of additional works required above the scope of works required for Option 1.

Figure 10: Stalybridge Option 4a aerial image, shorter cable route

Figure 11: Stalybridge Option 4b aerial image, longer cable route

1.39. The Single Line Diagram (SLD) below shows the basic HV electrical arrangement of the site for our preferred option. The proposed new shunt reactor and disconnector are highlighted in orange, connected to mesh corner 1 (MC1).

Figure 12: Stalybridge SLD

Do Nothing Option

1.40. A “do nothing” option would not satisfy the driver set out by NGESO. It would not address the needs of voltage control on the network in the Pennines region and would therefore not be in the interests of the consumer. A “do nothing” option is considered invalid and therefore not defined nor included in this paper.

Circuit breakers

1.41. Careful consideration has been given to the scope of works for each of the three chosen sites. The operational control of the shunt reactors must satisfy the needs of NGESO and those of the control room(s), for an effective management of the network. Ideally a new dedicated circuit breaker would be included in scope for each new shunt reactor, so that it can be switched in/out without impacting on other system operations and to mitigate any susceptible to ferroresonance where applicable. Point on Wave (POW) switching is a requirement of the shunt reactors which may not always be available with existing circuit breakers.

1.42. The decision hierarchy below defines the thought process, as a “top down” approach, for determining the appropriate course of action for each site.

1. **Use the existing mesh corner circuit breaker(s)** for use with the new shunt reactor.

   If not suitable then…

2. **Adapt/modify the existing mesh corner circuit breaker(s)** for use with the new shunt reactor.

   If not suitable then…

3. **Replace the existing mesh corner circuit breaker(s)** for use with the new shunt reactor.

   If not suitable then…

4. **Add a dedicated circuit breaker** for use with the new shunt reactor.

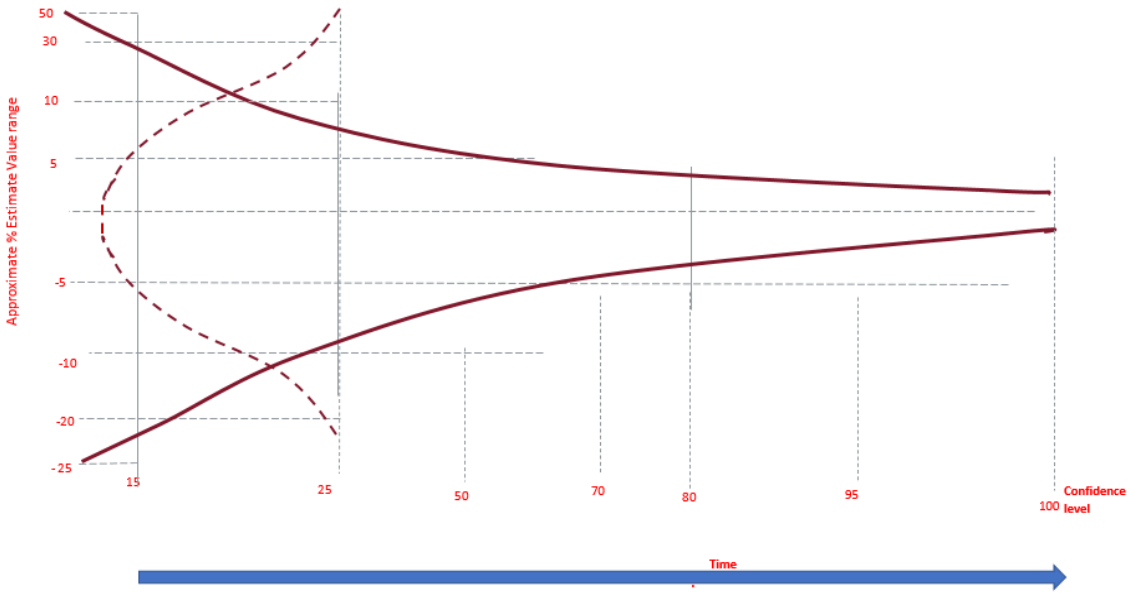
1.43. Table 2 below shows how each site progressed through the hierarchy to arrive at an appropriate solution.

Hierarchy	Stocksbridge	Bradford West	Stalybridge
(1) Use existing CB	Cannot be used for POW switching.	Cannot be used for POW switching.	Cannot be used for POW switching.
(2) Adapt/modify CB	Age/duty history of asset not suited.	Age/duty history of asset not suited.	Age/duty history of asset not suited.
(3) Replace CB	Meets the needs of the project subject to technical evaluation of system requirements	Site is a 4-switch mesh which means two CBs would need to be replaced, not cost effective.	May meet the needs of the project however risk given the constraints.
(4) Add dedicated CB	Would not fit in the available space at the substation without significant additional works at higher cost.	Meets the needs of the project.	Meets the needs of the project.

Table 2: Structure of the document

7. Preferred Options

1.44. The cost estimate of [redacted] are based on site specific information known at this time i.e., part way through the pre-construction development stage of the project. As such the estimate has a +/- 20% level of confidence at this stage as summarise in the diagram below. A more detailed breakdown of this estimate will be provided at a later date to align with the MSIP regulatory framework requirements.



Estimate Class	5	4	3	2	1
Maturity Level of Project Definition	0% to 9%	10% to 24%	25% to 44%	45% to 64%	65% to 100%
Estimate range	-20% to +30%	-15% to +20%	-10% to +10%	-5% to +5%	-3% to +3%

Figure 13: Diagram of cost estimate accuracy through the development process

Stocksbridge

1.45. To satisfy the driver at minimum cost, it is necessary to undertake the following works at Stocksbridge:

- [redacted]

1.46. [redacted]

Bradford West

1.47. To satisfy the driver at minimum cost, it is necessary to undertake the following works at Bradford West:

- [redacted]

Stalybridge

1.48. To satisfy the driver at minimum cost, it is necessary to undertake the following works at Stalybridge:

- [redacted]

8. Project delivery

Contracting Strategy

1.49. The Pennine Pathfinder shunt reactor scheme will be delivered using traditional preconstruction planning using front end engineering development (FEED) followed by placing construction contracts using NGET existing approved supplier frameworks.

1.50. The three sites are located in different National Grid regions and as such will be managed by the responsible Project Manager for that area team.

1.51. Once the preferred options were chosen for each site NGET produced a FEED scoping document that described the project objectives and design and survey requirements for the three sites. A key objective that must be met is that the designed solution must not hinder the site for future expansion or extension of busbars.

1.52. The scoping document went out to selected suppliers, returned outline proposals were evaluated against the project objectives and prices evaluated and a single FEED contract awarded. NGET retained a project management function to ensure its business objectives are met, providing its input when and where necessary and retained full accountability for producing the assured system design specification. [which confirms the functional requirements for how the new shunt reactors will be connected onto the transmission system and how the equipment is controlled].

1.53. The FEED consultant / NGET project management team are currently undertaking surveys, assessments and produced construction design specifications. Each site will have its own unique specification developed that considers site specific issues for example, overcoming delivery issues for the 200MVar shunt reactor at Stocksbridge substation, re-using existing bunds and removing the obsolete super grid transformers disconnected from the system.

1.54. Surveys and assessments included.

- Ground Penetration Radar (GPR)/Topographical survey
- Geotechnical and Geo - environmental desk top assessment
- Low Voltage Alternating Current (LVAC) assessment and making recommendations including inspections of existing Low Voltage (LV) troughs and cable routes and interconnection with Protection and Control (P&C) systems
- Suitability for Re-use Assessments for existing assets.
- Ecology
- Intrusive Geotechnical/Geo environmental specification and organising fieldworks and laboratory testing
- Transportation and swept path.

Programme Timeline

1.55. As per the ESO tender outcomes, the three sites must achieve the in-service date of 1 April 2024.

1.56. The Project Programme Milestones are shown in Table 3 on the following page:

1.57. In order to achieve our in-service date, orders have been placed for the 3 shunt reactors using NGET procurement bulk order and delivery will be made to the sites in Q3 FY 2023/2024.

1.58. The connection dates required by NGESO are relatively soon for a project of this type and we have had to make significant progress in order to meet the required in-service dates. As such the optioneering and development stages are compressed into relatively short timescales. We are therefore required to accelerate our activities and increase resources accordingly.

Project Programme Milestones	Stalybridge	

Stocksbridge	
Start	Finish

Bradford West	
Start	Finish

Table 3: Project Programme Milestones

9. Risks and Contingencies

1.59. We have a formal risk management process that is based on ISO 31000:2009. This process outlines how risks are managed by National Grid and once risks have been identified, how they will be managed through the development and construction phase.

1.60. Each site has been considered in the broader context of its geographical setting and site wide issues to install and operate new shunt reactors within existing National Grid substations. Hazard identification and risk management design meetings and workshops for the option analysis stage become more detailed as the risks become better understood through stakeholder engagement.

1.61. Each site has its own risk register. As we develop the project further, we will use a series of risk management techniques consequently the risk management will start to shift from qualitative (as below) to a quantitate basis as more becomes known.

1.62. The project risk registers are at a stage with early risk collation undertaken and initial mitigations / concerns identified. The below tables identify the top 5 risk areas for each of the individual shunt reactor sites, showing their current red, amber, or green status: -

Stocksbridge Shunt Reactor

Top 5 risks/concerns	***Description***

Table 4: Stocksbridge top 5 risks

Bradford West Shunt Reactor

Top 5 risks/concerns	***Description***

Table 5: Bradford West top 5 risks

Stalybridge Shunt Reactor

Top 5 risks/concerns	*Description*

Table 6: Stalybridge top 5 risks

10. Stakeholder Engagement

1.63. The key stakeholders identified by NGET in this project are:

- NGESO (Customer)
- Local Authorities
- Liberty Steel (neighbour of Stocksbridge substation)
- External customers wishing to connect
- Environment Agency
- Residents and business
- Highways England

Stakeholders - Taking delivery of the Shunt Reactors to Substations

1.64. Independent transportation engineers have been commissioned by National Grid to undertake a feasibility investigation into delivering the large items of plant.

1.65. This investigation will summarise the status of the current access arrangements and seeks to present the situation as it currently stands for delivering the shunt reactors into the United Kingdom and onward travel using highway infrastructure to the substations. It considers the potential land transport routes that we anticipate will require delivery under Special Order permission from Highways England.

1.66. At the time of writing this MSIP document the report is being finalised and it is understood no major areas of concern have been identified.

Stocksbridge

1.67. General access to Stocksbridge substation is via Liberty Steel. Topographically the National Grid substation itself overlooks the main part of the steel works and is served by paved roads. Historically the substation has been fitted with quad boosters. To enable delivery of large plant items, an existing dedicated access track comes off the nearby dual carriageway. NGET's agreed heavy load route is via this dedicated track. This will require the clearing of overgrown vegetation and minor repairs along with possible localised strength upgrades.

Bradford West

1.68. The substation is in a semi-rural location but does have a farm and other residential occupied buildings located nearby. Other wound plant inside the substation already has noise enclosures fitted so a noise enclosure will be provided over the shunt reactor.

Stalybridge

1.69. There are several houses / residential properties relatively close by Stalybridge substation. NGET will complete a noise assessment, but it is expected that the outcome of the study will be the shunt reactor must have an enclosure fitted. The project team has commenced this work and the design is progressing with this assumption, if the assessment concludes otherwise the decision to enclose the shunt reactor will be re-evaluated. The existing super grid transformer at Stalybridge is enclosed.

11.Overview of Assurance and Point of Contact

1.70. Appendix A contains the assurance statement letter that provides written confirmation in line with the assurance requirements set out in Ofgem's Re-opener Guidance, dated 03 February 2022[2].

1.71. This confirmation is provided by the New Infrastructure Regulation Manager, Electricity Transmission where they are accountable for re-opener submissions for National Grid Electricity Transmission (NGET) including any changes to these allowances. 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:

- It is accurate and robust, and the proposed outcomes of the MSIP submission are financeable and represent best value for consumers.
- 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.
- The application has been subject to internal governance arrangements and received sign off at an appropriate level within the licensee.

1.72. NGET's designated point of contact for this MSIP application is xxxxxxxxxxxxxxxx, Regulatory Development Manager, email xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx, telephone xxxxxxxxxxxxxxxxx.

[2] Re-opener Guidance and Application Requirements Document (ofgem.gov.uk)

12.Appendices

- Appendix A – Assurance Statement

APPENDIX A - Assurance Statement

- Appendix B – Ofgem Re-opener Guidance Note

APPENDIX B - Ofgem Document Guidance -

End.

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