national gas transmission

Huntingdon Compressor Emissions Re-opener

Asset Health EJP

June 2025

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Version control

Version/revision number	Date of issue	Notes
0.1	November 2024	First draft
0.11	April 2025	NGT review
Final	June 2025	Ofgem Submission

Contents

1 Executive Summary

1.1.1 National Gas Transmission (referred to in this regulatory submission as 'NGT, we, us and our') is submitting this funding request under the RIIO-T2 Compressor Emissions Re-opener and Price Control Deliverable Uncertainty Mechanism, in accordance with Licence Special Condition 3.11, Parts D and E, as per the Re-opener Guidance and Application Requirements Document and as per Price Control Deliverable Reporting Requirements and Methodology.

1.1.2 We are committed to reducing the impact of our activities on the environment. Critical to this is ensuring that our compressor fleet meets emissions limits as set out in the Medium Combustion Plant Directive (MCPD), while maintaining resilience to ensure Security of Supply.

1.1.3 Our Final Option Selection Report (FOSR), found in Appendix G, was submitted to Ofgem under Special Condition 3.11, Part C of the Licence in January 2023.

1.1.4 This Engineering Justification Paper (EJP), together with its supporting appendices, constitutes National Gas Transmission's Compressor Emissions cost re-opener submission for Huntingdon compressor station pursuant to Gas Transporter Licence Special Condition 3.11 Part D. The EJP explains the engineering justification, detailed scope, delivery plan, efficient costs and requested regulatory allowances for asset health interventions to Huntingdon Compressor Unit C.

1.1.5 Our objective for this cost re-opener submission was to identify the most cost-efficient asset health interventions to enable Unit C to operate efficiently under the 500-hour Emergency Use Derogation (EUD) option allowed for in the MCPD. This supports our commitment to reducing the impact of our activities on the environment.

1.1.6 We gathered information on asset condition from a Pre-FEED study and undertook site surveys to identify potential interventions to both address the need case and to inform scope definition and cost estimation. Where possible, we considered a range of intervention options from do-nothing, through to minor refurbishment, major refurbishment or replacement, as detailed in Section 6.

1.1.7 Following the survey recommendations, the preferred scope and cost has significantly developed from the FOSR due to varying factors such as asset condition and material price increases. A detailed explanation is included in Section 8.

1.1.8 Previously, there were three compressor units at Huntingdon (A, B and C) all of which were Siemens SGT-A20 1533 (formally Rolls-Royce Avon) units. Units A and B, commissioned in 1989, were removed from service and are scheduled to be demolished later in 2025. Units D and E (Solar T130s), replacing Units A and B, were commissioned in RIIO-T2 and comply with the Integrated Pollution Prevention and Control (IPPC) legislation. Unit C remains operational and has the potential to breach the Nitrogen Oxide limits imposed by the MCPD legislation and will therefore be non-compliant from 2030.

1.1.9 We request the award of non-baseline re-opener allowances (CEPOt) of [redacted] across RIIO-T2 and RIIO-GT3 price control periods as shown in Table 3, to be incorporated by licence direction into an amended PCD output for asset health scope on Unit C with a completion and handover date of December 2029 and project closure by February 2030.

1.1.10 Delivery of this project by 2030 will continue to support the network with Unit C providing back up to ensure our customers continue to receive gas at specified volume and pressure, therefore providing the necessary level of network resilience.

1.1.11 [redacted]

1.1.12 To proceed as planned, we would respectfully request Ofgem target Draft Determination (DD) by September 2025 and Final Determination (FD) by December 2025. This is aligned with Ofgem's re-opener guidance, para A11.21. As such, we are keen to support Ofgem in their review process to permit a timely decision.

1.1.13 The project is at Network Development (ND500) project stage 4.4, with completed surveys to define scope and project boundaries, which helps place cost confidence within the range of +/-15%.

1.1.14 A Regulatory Cover Note detailing the relationship between Peterborough and Huntingdon Compressor Emissions re-opener submission is included in the submission pack.

2 Introduction

2.1.1 Huntingdon compressor station plays a critical role in meeting multiple supply and demand conditions. These include moving gas towards demand from multiple regions, primarily from North to South. In the event of low supply from Milford Haven LNG terminal, it supports moving gas away from Bacton into the West of the network. Its central location on the network also positions it to provide overall operational flexibility for the National Transmission System (NTS).

2.1.2 The location of Huntingdon Station in relation to the network is illustrated in Figure 1.

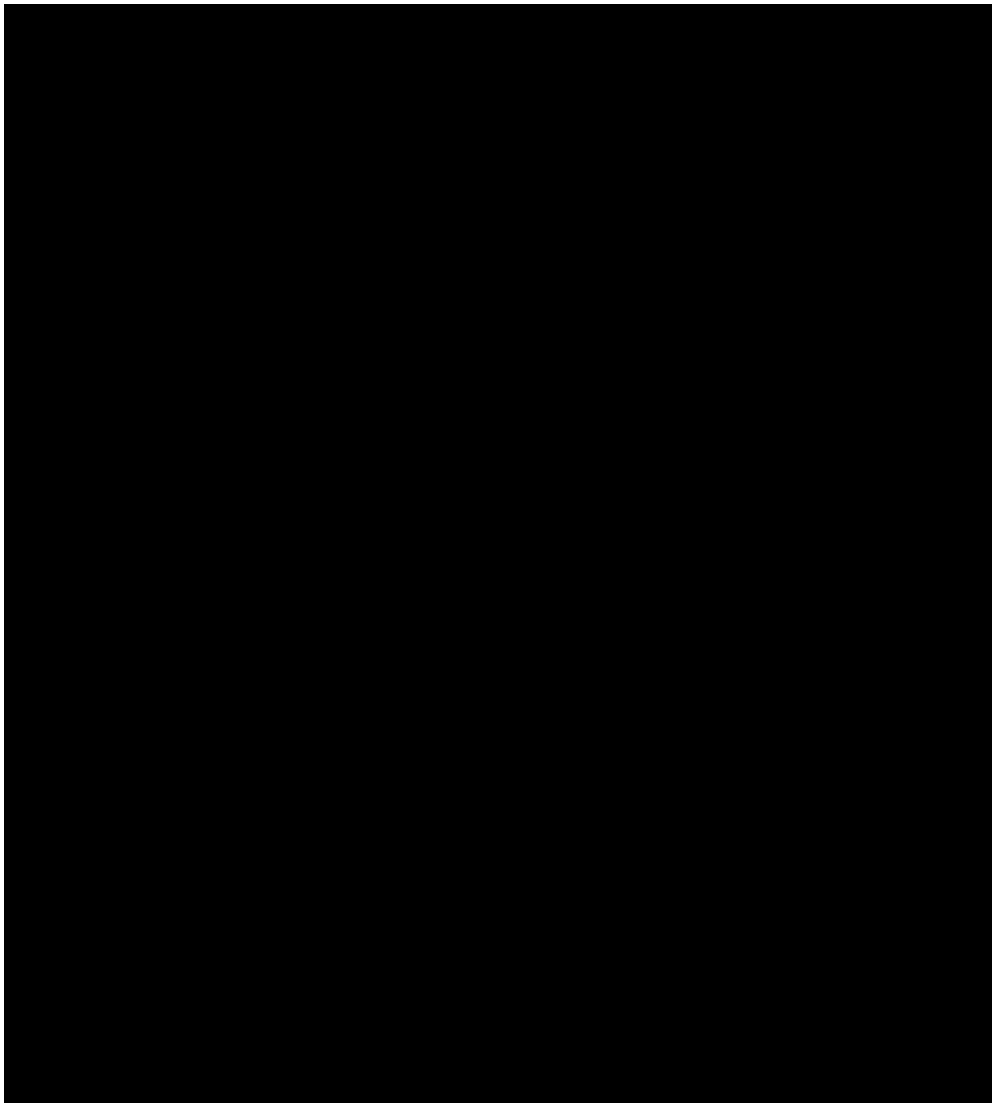

Figure 1: NTS with Location of Huntingdon Highlighted

2.1.3 Following the FOSR submission, the preferred option to comply with MCPD from January 2030 for Huntingdon Unit C was the counterfactual option. The unit will be retained under the 500-hour Emergency Use Derogation (EUD) allowed for in the directive with significant investment required to improve unit availability. The FOSR detailed costs at a +/- 30% confidence.

2.1.4 Table 1 below sets out the FOSR options submitted to Ofgem for Huntingdon MCPD Project.

FOSR Option	Unit A	Unit B	Unit C	Unit D	Unit E	Unit F
1 – Counterfactual	Removed	Removed	500Hr EUD	No Change	No Change	-
2 – CSRP	Removed	Removed	CSRP Retrofit	No Change	No Change	-
3 – SCR	Removed	Removed	1533 DLE Retrofit	No Change	No Change	-

Table 1: Huntingdon FOSR Options

2.1.5 Figure 2 below shows an aerial view of Huntingdon compressor station with Unit C identified.

2.1.6 To confirm the works required to improve the unit's operational condition, Electrical and Mechanical Asset Health surveys were completed in December 2024 (Appendix E). The results have been challenged by our engineering discipline Subject Matter Experts (SMEs) to achieve the most economic and efficient solution which will extend the asset life to 2050.

2.1.7 Upon implementation of the proposed investments, Unit C will be derogated in line with MCPD and enable the station to operate at maximum capacity to support security of supply.

2.1.8 This EJP interacts with other documents to form the Huntingdon re-opener submission pack as illustrated in Figure 3 below.

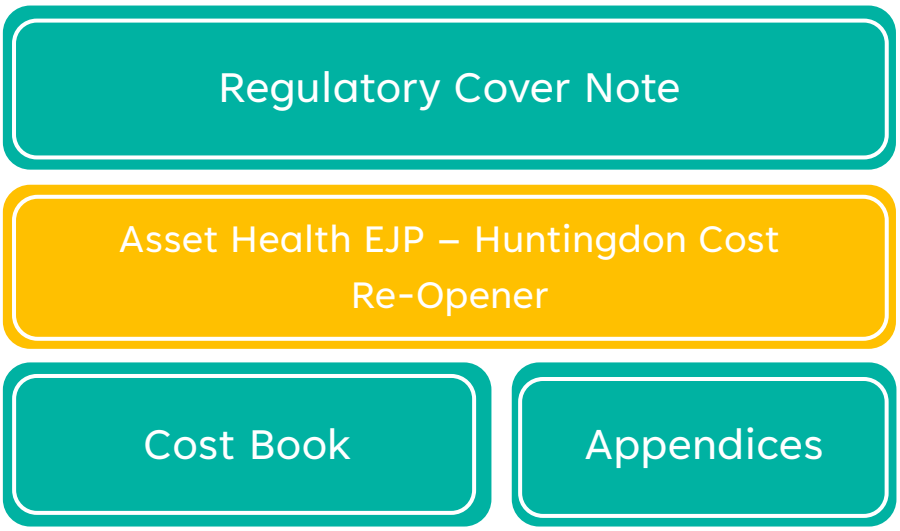

Figure 3: Huntingdon Re-opener Submission Pack

Summary Table

2.1.9 Our objective for this re-opener is to request non-baseline (CEPOt) funding for the project set out in this application. The EJP is submitted with defined scope, outputs and costed project plans, developed post the FOSR submission in January 2023. The request covers:

- True-up of baseline FOSR allowances
- Non-baseline allowances for asset health interventions on Unit C

2.1.10 Our request for funding through this document is made against Special Condition 3.11 Compressor Emissions Re-

opener and Price Control Deliverable and is outlined in Table 2. This is aligned to the Regulatory Reporting Pack (RRP).

Name of Project	Huntingdon Asset Health Compressor Emissions
Scheme Reference	PAC1204851
Primary Investment Driver	Compliance with MCPD legislation
Mechanism or Category	Special Condition 3.11: CEPt – Price Control Deliverable term CEPOt – Re-opener Allowance
Project Initiation Year	FY2022
Project Close Out Year	FY2030
Estimate at Completion (EAC) (£m, 2018/19)	[redacted]
[redacted]	[redacted]
Current Project Stage Gate	ND500 (4.4) Project Execution
Relevant Delivery U.I.Ds	Ref - Table 11 of this document
Outputs PCDs	Ref - Table 5 of this document

Table 2: Summary table for Huntingdon Compressor Asset Health

2.1.11 Table 3 below sets out the cost summary for delivering the selected final option for this project. This is further detailed in the Cost Book Appendix A.

	RIIO-T2					RIIO-GT3				
(2018/19 price base)	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**	**FY30**	**Total**
[redacted]										

Table 3: Huntingdon Asset Health Cost Summary

3 Licence Conditions, PCD Output and Funding Request

3.1.1 This submission has been prepared in accordance with the Gas Transporter Licence Special Condition 3.11 Part D and includes a level of detail in line with Ofgem's RIIO-T2 Re-opener Guidance and Application Requirements Document: Version 3 ('the Guidance')[1].

3.1.2 In accordance with section 2.2 of the Guidance, this application is accompanied by an assurance statement (Appendix B) to comply with Ofgem's requirement for written confirmation from a suitable senior person within the company that the re-opener application has been appropriately assured. Appendix C presents a cross-reference to indicate where each of Ofgem's re-opener application requirements guidance is fulfilled within our submission.

3.1.3 Special Condition 3.11 of our Licence relates to Compressor Emissions Re-openers and enables us to request an adjustment to the value based on the following licence terms:

- Price Control Deliverable term – CEP*t*
- Re-opener allowance - CEPO*t*

3.1.4 Huntingdon Compressor Station Cost Re-opener (CEPOt) provides the mechanism for the submission. In accordance with licence condition 3.11 Part D, our submission aims to modify the outputs, delivery dates and allowances detailed in Table 4.

3.1.5 In accordance with Licence condition 3.11 the submission seeks to modify the values within the Gas Transmission RIIO-T2 Price Control Financial Model (PCFM). In accordance with licence condition 3.11, Part E, our submission seeks to provide details of actual and forecast (i.e. true up) of Baseline allowances received noting updated values in Appendix 1.

3.1.6 This follows Price Control Deliverable (PCD) Reporting Requirements and Methodology[2] (paragraph 7.4) where the delivery of a PCD output is a trigger for a re-opener submission or is the re-opener submission, the PCD assessment will be undertaken as part of the re-opener assessment.

3.1.7 In addition, Ofgem's RIIO-T2 Final Determination notes that Ofgem expects to true up baseline funding as part of the Compressor Emissions re-opener determination. As part of pre-submission engagement, we have raised the issue of how and when Ofgem intends to approach the true up and PCD assessment.

Price Control Deliverable

3.1.8 Table 4 below shows a summary of the current PCD for Huntingdon aligned to Appendix 2 of the Licence.

Site	Output	Delivery Date	Re-opener application window	Total allowance (all years) (£m) 2018/19 Price base
Peterborough and Huntingdon	Final Option Selection Report[3]	January 2023	June 2025	[redacted]

Table 4: Huntingdon Baseline Funding and PCD

3.1.9 Table 5 below is a summary of the proposed Price Control Deliverables (PCD) Output associated with the delivery of the proposed re-opener scope for Unit C.

Price Control Deliverable - Emissions compliant compressor at Huntingdon			
Site	**MCPD Option**	**Output Description**	**Delivery Date**
Huntingdon	Asset Health	Compressor Unit C asset health including mechanical and electrical interventions to improve its availability and reliability. Completion demonstrated with NGT Management and Control Procedure T/PM/G/35, specifically Operational Acceptance Certificate.	[redacted]

Table 5: Huntingdon Proposed PCD and Funding

FOSR Baseline Funding

3.1.10 We were awarded [redacted] (2018/19 prices) baseline funding for Peterborough and Huntingdon. The funding was to undertake feasibility, a conceptual study and develop the options to determine a preferred solution. The outputs are

[1] Re-opener Guidance and Application Requirements Document: Version 3 | Ofgem
[2] Version 4, published by Ofgem 25 August 2023
[3] As per Ofgem's RIIO-T2 Final Determinations published in December 2020, this PCD is to ensure NGT delivered a Final Options Selection Report, long lead items and the re-opener submission.

summarised in the Final Option Selection Report (FOSR).

3.1.11 The spend to date as of April 2025 for Huntingdon only is [redacted] This spend has been quantified within the Huntingdon Cost Book (Appendix A).

3.1.12 The decision to split the sites for re-opener submission and the internal baseline funding split is detailed in the accompanying Regulatory Cover Note.

3.1.13 Our view is that the current Price Control Deliverable (PCD) is fully delivered given we have submitted both the FOSR and re-opener cost submissions in full by the designated delivery dates, and that this re-opener is aligned to Ofgem's approved Final Preferred Option.

Regulatory Statement

3.1.14 Our submission includes a funding request for valves and filter assets which are also included in our RIIO-GT3 business plan. Table 12 highlights the relevant crossover asset types and volumes. Given the detailed scope derived from recent surveys and cost confidence from market pricing for this re-opener, we suggest it would be appropriate these are funded via this RIIO-T2 Compressor Emissions re-opener submission.

3.1.15 If Ofgem agrees and awards allowances for these works, we propose that the corresponding asset volumes are reduced in the NGT RIIO-GT3 licence proposals or via a RIIO-GT3 licence modification (depending on when the re-opener decision is finalised).

3.1.16 Our designated point of contact for this re-opener application is [redacted]

3.1.17 In line with section 2.4 and 2.5 of the Guidance, this document and supporting business case documents will be published in their entirety within five days of submission, with only necessary redactions. Publication will include an explanation for any redactions.

3.1.18 All costs presented in this document are in a 2018/19 price base (or an explanation is provided if it is otherwise).

Re-opener Funding Request

3.1.19 This re-opener application pack is proposing revised outputs, delivery timescales and allowances detailed in Tables 5 and 6. Ofgem are invited to assess and approve our cost proposal for Huntingdon in line with Special Condition 3.11.

3.1.20 Table 6 below sets out the total funding request to deliver the MCPD scope and associated works at Huntingdon (2018/19 price base). Further details are included within the cost book (Appendix A). The direct costs aligned to CEPOt represent the allowances requested, as this project is subject to the Opex Escalator (Special Condition 3.18 of the Licence).

Huntingdon Only	RIIO-T2					RIIO-GT3				
GD-T RIIO2 PCFM terms	21/22 (£m)	22/23 (£m)	23/24 (£m)	24/25 (£m)	25/26 (£m)	26/27 (£m)	27/28 (£m)	28/29 (£m)	29/30 (£m)	**Total (£m)**
Current Allowances										
[redacted]										

Table 6: June 2025 Huntingdon MCPD Compliance Cost Profile

4 Equipment Summary

4.1.1 Huntingdon Compressor Unit C, which was commissioned in 1992, is a Siemens SGT-A20 gas turbine engine. An overview of the unit is provided in Table 7.

Unit	Engine	Fuel Type	Power Base (MW)	Installation Date	Minimum Operational Flow (mscm/d)	Nominal Capacity (mscm/d)
Huntingdon Unit C						

Table 7: Huntingdon Compressor Asset Overview

4.1.2 As shown in Figure 4, the unit is a model of the Rolls-Royce (now Siemens) gas turbine engine, specifically designed for industrial applications. It's an aero-derivative gas turbine, meaning it was originally developed from an aircraft engine design, but adapted for industrial use. The SGT-A20 is commonly used in power generation and mechanical drive applications, such as driving compressors and pumps in the oil and gas industry.

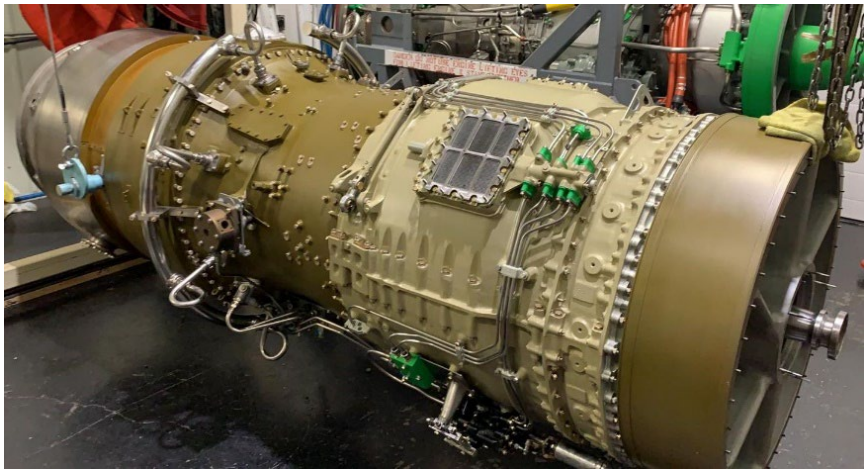

Figure 4: Siemens Avon MK1533

Huntingdon Unit C Asset Health Mechanical Sub-Asset Summary

4.1.3 Below is a summary description of the components being addressed as a part of the asset health interventions on Unit C. The findings and recommended solutions are further detailed in Section 5 Problem Statement and Section 6 Options Considered.

4.1.4 **Pipework** - The pipework systems include suction, discharge, vent, and bypass lines, suction and discharge lines route gas through the compressor. By-pass and venting pipework are critical during emergency shutdowns or routine de-gassing of the Compressor for maintenance activities. Figures 5 and 6 below show some Unit C pipework.

Figure 5: Pipework – Suction Line

Figure 6: Pipework - Discharge Lines

4.1.5 **Valves** – Valves on all systems related to Unit C are critical for either routine valve operations or isolation. Routine valve operations open a flow path to direct gas flow to / via the Compressor, by-pass or vent lines. If the unit is to operate effectively and safely, these valves must open and close on demand to either allow gas to flow to / via the Compressor or provide an effective seal when closed (gas flow routing and / or flow stopping).

4.1.6 Isolation valves are required to provide an effective seal against the gas flow during maintenance activities. Typically, two isolation valves with a vent to atmosphere (double block and bleed arrangement) are required to confirm that a secure isolation has been achieved. The setup ensures that any residual gas is safely vented through the vent valve making the downstream gas assets safe for maintenance work. Figure 7 below is the current condition of a Unit C valve.

Figure 7: Suction Line Valves

4.1.7 **Gas Actuators** – Actuators provide the motive force to open or close a valve on demand. This demand is driven by Control System design (operational functionality) or manual intervention by the Compressor Unit Operator(s). Actuators, like the valves they operate, are critical to the operation and safety of the Compressor in routing gas flows correctly or for making isolations for maintenance activities. Figure 8 below shows the current condition of an actuator for Unit C.

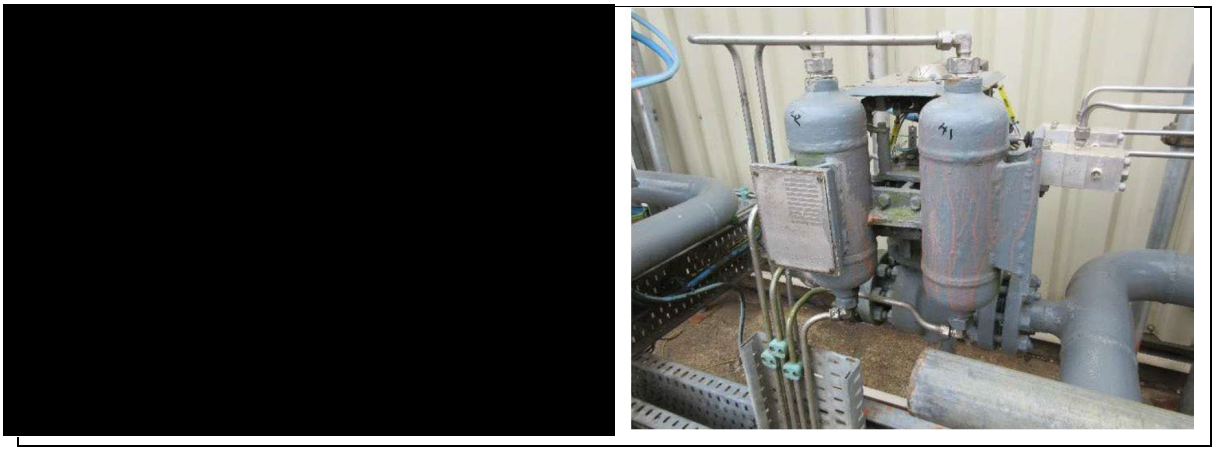

Figure 8: Gas Actuators

4.1.1 **Lube Oil System** - The lube oil system, including heat exchangers, filters, pumps and the bulk tank is critical in providing essential lubrication to the Gas Generator, Power Turbine and Compressor. Failure of the Lube Oil System would render the compressor unit inoperable. Figure 9 below shows current condition of lube oil system.

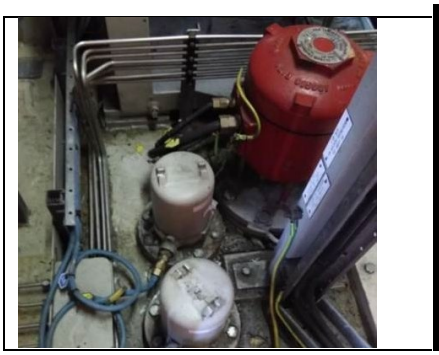
[redacted]

Figure 9: Lube Oil Heater

4.1.2 **Fuel Gas Inlet System** - The inlet fuel gas system supplies clean, pressurised fuel gas to the compressor, ensuring efficient operation. It is fed from the pressure reduction area skid. Figure 10 below shows current condition of the fuel gas inlet pit.

Figure 10: Fuel Gas Inlet Pit

Huntingdon Unit C Asset Health Electrical Sub-Asset Summary

4.1.3 **Low Voltage (LV) Switchboards** – In an electric power system, switchgear is the combination of electrical disconnect switches, fuses or circuit breakers used to control, protect and isolate electrical equipment. Switchgear is used both to deenergise equipment to allow work to be done and to clear faults downstream. Switchgear also provides isolation of circuits from power supplies. Switchgear is in use at virtually every site on the NTS where electrical equipment is installed. Figure 11 below shows the LV switchboard for Unit C.

[redacted]

Figure 11: Low Voltage Switchboards

4.1.4 **Motor Control Centre (MCC) -** The Unit C specific MCC controls all electrical motors on Compressor Unit C, including motor starters, fuses / circuit breakers and power disconnect. The MCC is critical for operation and maintenance of all electrical motors. Failure of the MCC or individual components would mean loss of critical motive power to motors and pumps required to safely and effectively operate the Compressor. Figure 12 below shows the motor control centre.

Figure 12: Motor Control Centre

4.1.5 **Distribution Boards** - Centrally distribute electricity to various circuits for Compressor Unit C. Circuit breakers or fuses inside these distribution boards help protect and control electrical circuits within the system. As with the MCC, failure of the Distribution Boards or individual components would mean loss of critical safety and operational systems required to safely and effectively operate the compressor.

4.1.6 **Motors** - All motors provide motive force to drive critical components of the Compressor. These range from small motors for such systems as oil lubrication for the Gas Generator, Power Turbine and Compressor, to larger motors such as the main starter motor for the Compressor Power Train (Gas Generator, Power Turbine and Compressor). Figure 13 below shows the current condition of the motors for Unit C.

4.1.7 **Cables –** Cables connect Low Voltage Electrical MCC and Distribution Boards to field devices via local Junction Boxes. The field devices cables provide power to are critical components of operational and safety critical systems essential for the safe operation of the compressor unit as well as the safety of operational personnel. Degradation or failure of cables result in loss of critical systems to operate the compressor unit and / or compromise the Safety of Operational personnel. Figure 14 below shows some cable runs.

Figure 14: Cables and auxiliaries

4.1.8 **Lighting -** Lighting, internal and/or external, is provided at virtually all operational sites as required to enable safe

access and use of internal and external areas for the purpose of operational and maintenance activities. Technology innovations, such as LED systems, present an opportunity to specify more energy efficient lighting options and reduce ongoing operation and maintenance costs. External lighting is generally sensor triggered at rural locations to minimise light pollution. Figure 15 below shows current Unit C lighting.

Figure 15: Internal and External CAB Lighting

4.1.1 **Arc Flash Assessment -** An arc flash is a release of energy through an electrical arc. This happens when an electrical current passes through air between ungrounded conductors or between ungrounded and grounded conductors. In simpler terms, the effects of an arc flash event mirror that of a bomb.

4.1.2 Energy is released in the form of heat, intense ultraviolet and infrared light, blast pressure waves and intense sound waves. Smoke, toxic fumes, molten metal and flying shrapnel may accompany the electrical event. Any person in proximity to an arc flash blast can suffer injuries as severe as burns, collapsed lungs, loss of vision, ruptured eardrums, soft tissue injuries, broken bones or even death.

4.1.3 Under the Electricity at Work Regulations and the Management of Health and Safety at Work Regulations, employers are required to undertake an arc flash assessment which involves analysing an organisation's electrical systems to determine the incident energy level which quantifies the potential thermal energy exposure from an arc flash event and the required personal protective equipment (PPE) for workers.

4.1.4 An arc flesh assessment helps to identify arc flash hazards and to estimate the likelihood of severe injury. The study determines additional protections needed for electrical safety in the workplace. It is an absolute mandatory requirement in law that arc flash hazards are reduced to the lowest level to protect people from harm. Arc flash assessments have been undertaken on the Unit C associated electrical panels including MCC, LV Switchgear and General Services Board to ascertain required interventions to meet this legislative requirement.

5 Problem Statement

5.1.1 Unit C is now over 30 years old and will be non-compliant with MCPD directive from 1 January 2030. The plan for Unit C is to limit the usage of the unit under derogation and operate it as an emergency use asset when flexibility and support is required on the NTS. The following paragraphs explain the key drivers that justify the scope requested to deliver the option selected during previous FOSR submission and review process.

MCPD Legislation

5.1.2 National Gas's compressors need to comply with the Medium Combustion Plant Directive (MCPD) and the deadline for compliance is 1 January 2030.

5.1.3 The options available for compliance are as follow:

1. Limit the usage of the unit under derogation
2. Apply emission abatement technology (CSRP/SCR/DLE)
3. Removal of the unit: disconnection or decommissioning
4. Build new compliant units.

5.1.4 The Final Preferred Option approved by Ofgem in November 2023 to comply with MCPD by 2030 is Option 1, the counterfactual option. It was agreed that the non-compliant SGT-A20 Unit C is to be retained under the 500-hour Emergency Use Derogation (EUD) allowed for in the Directive, with significant asset health investment to improve unit availability and operational performance until 2050.

5.1.5 Dry Low Emission (DLE) retrofit technology is not currently available for SGT-A20 compressors. The Control System Restricted Performance (CSRP) has been rejected as a solution by the Environmental Agency. Selective Catalyst Reduction (SCR) technology was found not suitable commercially and technologically to the SGT-A20 compressor. As a result, emission abatement technology has been excluded as an MCPD compliance option for Huntingdon Unit C.

5.1.6 [redacted]

5.1.7 The identified asset health interventions will require investments in RIIO-T2 to initiate the project, and complete design and delivery in RIIO-GT3 as highlighted in Table 3. The proposed delivery volumes are detailed in Table 12 and the project delivery timeline is highlighted in Table 14.

Standards and Specifications

5.1.8 The following industry standards, specifications, and our guidance documents were reviewed to ensure that the asset health assessment of the compressor Unit C was conducted in alignment with recognised best practices, legislative requirements, and established technical criteria by National Gas.

5.1.9 The following guided the evaluation of the electrical equipment integrity, operational functionality, maintenance standards, and overall compliance.

- Electricity at Work Regulations 1989
- Management of Health and Safety at Work Regulations 1999
- IEC 604391: Low Voltage Switchgear and Control gear
- T/PM/COMP/20: Compressor Installations for the National Transmission System
- T/SP/COMP/30: Control & Instrumentation Systems on Compressor Installations
- T/SP/EL/50: Gas Transmission Electrical Specifications

5.1.10 Concurrently, the following assisted the evaluation of the mechanical equipment.

- API STD 614: Lubrication, Shaft-sealing and Oil-control Systems and Auxiliaries
- T/SP/CM/4: The assessment and reporting of plant coatings, painting & cladding inspections for national

transmission system assets

- T/PR/MAINT/5033: Work procedure for the functional check of “ancillary” small bore valves with inlet pressures above 7 bar
- T/PM/PSR/4: Ensuring compliance with the Pipelines Safety Regulations 1996.
- T/PM/PS/3: Ensuring compliance with the Pressure Systems Safety Regulations 2000.
- T/PM/MAINT/6: Maintenance of terminals and compressor installations operating on the national transmission system (excluding PSSR inspections)
- T/PM/SCO/91: Safe Control of Operations at Gas Transmission Sites
- GIS/V6:2019: Steel Valves for the use with natural Gas at normal operating pressure above 7 bar and sizes above DN15
- T/SP/V/6: Specification for steel valves for use with natural gas at normal operating pressure above 7 bar and sizes above DN15
- T/SP/VA/5: Specification for Flow Control Valves
- T/SP/VA/1: Technical specification for fluid powered actuators for two position (OPEN/ CLOSED) quarter turn valves.
- T/SP/VA/2: Technical specification for electrically powered actuators for two position (OPEN/ CLOSED) quarter turn valves.
- T/SP/VA/4: Electro-Hydraulic Actuators for Two Position (Open/Closed) Quarter Turn Valves

Unit C Defects and Asset Deterioration

5.1.11 In addition to the recommended scope to deliver asset health interventions as detailed in the Asset Health Survey Report (Appendix E), Table 8 below shows a summary of current defects, examples of faults and associated risks. This is further detailed in the Huntingdon Unit C Defects List (Appendix I). Without the interventions, it is highly probable that the quantity of defects will escalate and negatively impact the flexibility and reliability of the station.

5.1.12 [redacted]

[redacted]

5.1.13 As described in Table 8 and detailed further on the defects list (DL) Appendix I, there are current defects that will [redacted]

The Mechanical Sub-Asset Health Survey Report Summary

5.1.14 This is a summary report of the evaluated mechanical sub-assets critical to the operation of Unit C. The aim of the recommendations was to ensure the operational reliability and safety of these sub-assets for a 25-year life extension. The scope for each intervention is detailed in Section 5 of the Asset Health Survey Report (Appendix E).

A summary of the survey findings and recommended asset health interventions is provided below.

5.1.15 **Pipework** - The pipework system was assessed to be well-maintained overall, but localised concerns, such as surface corrosion, paint deterioration, and missing fasteners require corrective intervention. No significant structural defects were identified. [redacted]

[redacted]

5.1.16 **Valves** - Valves across the station exhibited corrosion, leaking flanges, and coating degradation. These issues, coupled with operational challenges such as frozen impulse lines (a common indication of passing valves) and valve obsolescence, necessitate a replacement programme. This includes valve replacements and corrosion treatment to adjacent connecting pipework to ensure long-term reliability.

5.1.17 **Actuators** - Gas-over-oil actuators, while still operationally sound, have exceeded their design life and face challenges such as emissions from venting and limited spare part availability. Transitioning to modern electric or electro-hydraulic systems is recommended to improve safety, reduce environmental impact, and ensure compliance with our specifications.

5.1.18 **Lube Oil System** - The lube oil system was assessed to be well-maintained overall, but localised concerns, such as corrosion under insulation and thinning in specific tank areas, require immediate attention to prevent risk of leaks. Proactive remediation is advised to secure the system's reliability for 25 years.

5.1.19 **Fuel Gas Inlet System** - The inlet fuel gas system supplies clean pressurised fuel gas to the compressor, ensuring efficient operation. It is fed from the pressure reduction area skid. The pressure reduction area skid was designed to supply fuel gas to Units A, B and C, and exhibits corrosion and coating defects. As Units A and B are being removed, the pressure reduction skid requires a combination of rationalisation and major refurbishment. This scope is detailed in Section 5 of the Asset Health Survey Report (Appendix F).

5.1.20 **Mechanical Conclusions** - Recommendations across all systems are centred on a strategic balance between cost and long-term performance. Minor refurbishment is suitable for addressing immediate concerns in most pipework systems, while major replacement is recommended for valves and actuators to address obsolescence and safety risks. In the case of actuators, a phased transition to modern systems is recommended. For the lube oil system, consistent monitoring and targeted remediation will ensure sustained operability.

The Electrical Sub-Asset Health Survey Report Summary

5.1.21 This is the summary report of the evaluated electrical components critical to the operation of Huntingdon Unit C, focusing on LV Switchboards and MCCs, Distribution Boards, Motors, Cables, Lighting, Suction and Discharge valve Gas Actuators. The aim was to ensure the operational reliability and safety of these components to 2050. This is further detailed in the Asset Health Survey Report (Appendix F).

5.1.22 Several sub-asset concerns were discovered and highlighted in the survey report prompting the need to consider the required investment. Of major concern is the deterioration of systems due to age, corrosion, and wear. This has resulted in increasing defects or known issues being recorded and the asset becoming unreliable, unsafe to operate or difficult to maintain.

5.1.23 The assets electrical systems in this scope are no longer suitable from a personnel and equipment safety perspective as they are non-compliant with arc flash protection standards as further detailed in this EJP's Problem Statement (Section 5).

5.1.24 Spares obsolescence, which will worsen over the next 25 years, will significantly affect maintenance and reliability. The identified electrical systems spares are no longer supported by the respective manufacturers.

5.1.25 Of concern is the failure of several of these assets to comply with BS EN /IEC 61439, which is a standardised set of safety requirements for power switchgear and control gear assemblies. The purpose of the standard is to harmonise existing general regulations and obligations. It aims to achieve uniform expectations and verifications for LV Switchboards and control gear assemblies.

5.1.26 Also, of importance to us is the compliance of all relevant electrical assets to the Gas Transmission Electrical Specifications (T/SP/EL/50). This electrical specification covers the design, manufacture, supply, construction, installation, inspection, testing and commissioning of the main types and aspects of electrical equipment.

A summary of the survey findings and recommended asset health interventions is provided below.

5.1.27 **LV Switchboards** - As a conclusion based on the performed Insulation Resistance (IR) test, continuity test, visual inspection tests, photographs taken, and data collected on defects, these switchboards are aged, non-compliant with legislation and obsolete with no spares available in the market, therefore replacements are recommended.

5.1.28 The Main LV Switchboard supplies alternating current (AC) and direct current (DC) to the Compressor Acoustic Building (CAB) C Motor Control Centre (MCCs). They originate in the old control building and are due to be demolished in 2025 as part of the station upgrade project within the RIIO-GT3 Cyber scope of works.

5.1.29 It is envisaged that the 415VAC supply to CAB C MCC and the 110VDC supply to CAB C will then originate from a new LV Board spare circuit breaker and from the new 110VDC Distribution Board in the recently built new control building. The electrical protection between the CAB C MCCs and the new control building LV Boards will need to be integrated to provide adequate segregation for the new supply cables and the CAB C MCCs.

5.1.30 **Motor Control Centre (MCC)** - These MCC switchboards were supplied with the original plant. Due to the age of equipment, the form of construction does not meet the requirements of present active British and International Electrotechnical Commission (IEC) standards, and the Electricity at Work Regulations which is rooted in the Health and Safety at Work Act.

5.1.31 For example, there is no mechanical segregation between the outgoing circuits, and forms of separation as defined in BS EN 61439-1:2011. These switchboards appear to have been constructed to Form 3 of the above standard. The present revision of National Gas Electrical Safety Rules SCO 96 requires that each outgoing circuit from a switchboard is fully segregated from adjacent live circuits as part of the isolation procedure.

5.1.32 **Distribution Boards** - The general services switchboard within the existing switch room and control room building supplies power to site DC emergency systems via a DC uninterruptible power supply (UPS). General site power and lighting is of the same pattern as the Unit C MCC switchboard. No motor manager relays are fitted.

5.1.33 [redacted] identified Distribution Boards as obsolete with no spares available to support maintenance. Internal discussions considered conducting an obsolescence review, with the board OEM to look at options for retaining in service (with some component replacement/upgrade) or installing new, current generation distribution boards. It was agreed that the preferred option is to replace the boards with new, as summarised in Table 10. This will provide an increased level of availability (and a degree of future proofing) to sustain operation throughout remnant life.

5.1.34 **Motors** - While still operationally sound, these LV motors have exceeded their design life and are assumed to be low-efficiency units, which may lead to higher energy consumption over time and increased OPEX costs. Their long-term viability also remains uncertain due to ageing components, lack of efficiency improvements and uncertain OEM support. Given these concerns and the objective of achieving a 25-year service life extension, a full replacement strategy has been identified as the optimal solution.

5.1.35 **Cables** – A study of both maintainability records and the asset health survey found the cable condition of both internal and external of the CAB (visual inspection) to appear in a suitable condition.

5.1.36 General reference is made to T/SP/EL/50 and T/SP/EL/30 specification requirements for LV cabling and the following points were found during the survey. The original cable systems were designed for an operating life of 40 years and have reached their recommended end of life. Normally the cable life will be around 40 to 50 years and if there is no change in environmental conditions and no sign of failure there is no need of immediate change.

5.1.37 The outer sheaths of cables do not have reduced flame propagation characteristics in accordance with IEC 60332, BS EN 60754 and BS EN 61034, and are not anti-vermin impregnated or provided with suitable mechanical means of anti-vermin protection.

5.1.38 LV cables outer sheaths of wires and cables (including insulated earthing) do not have Low Smoke Zero Halogen (LSZH) characteristics and are not Flame Retardant XLPE SWA LSZH type. Where LV cables were installed outdoor, they show signs of UV damage to the outer insulation. In general, the installed [redacted]

5.1.39 The replacement of MCCs and LV switchgear will require the replacement of the associated interconnecting cables as the cables must also be replaced to current technology to support the new switchgear and MCC and must be of the correct length to terminate at new cabinet locations. Replacement also supports the requirement to provide the required 25-year life extension.

5.1.40 **Lighting** - The transition from fluorescent-based fixtures, installed during the unit's commissioning in 1992 to state-of-the-art Light Emitting Diode (LED) technology adheres rigorously to the latest British Standards (BS) and National Gas technical standards for electrical systems. Full lighting replacement with modern LEDs is required to address obsolete technology and corrosion and maintain legislative compliance.

5.1.41 **Gas Actuators** - The present Gas Compressor's suction and discharge valves are gas driven actuators. This type of actuator drive can develop defects over time that make it non-compliant with the Dangerous Substance and Explosive Atmospheres Regulations 2002 (DSEAR) and Pressure Systems Safety Regulations 2000 (PSSR) and requires to be replaced due to the defects, age and condition of the asset at Huntingdon. The preferred option for Huntingdon is to replace the present actuators with electric/hydraulic actuators thereby negating the need for actuating gas pipework.

5.1.42 **Arc Flash Assessment** – based on the assessment and information collected at site, high arc flash incident energy levels pose unacceptable safety risks and supports replacement of the MCC and LV switchgear.

5.1.43 **Electrical Conclusion** - The proposed recommendations across all systems focused on compliance with the current UK

and international safety standards to enhance site resilience for the foreseeable future. Doing these works now not only addresses the mandatory safety and Regulatory issues identified above but is also necessary to affect the change in valve actuation from gas hydraulic to electric / electro-hydraulic due to the additional electrical loads on the infrastructure.

5.1.44 The cost to deliver this scope is further described in Section 8. We have conducted a comprehensive review of the survey outcomes and agreed interventions with MWC, we have also challenged the costs by benchmarking against similar historical works across the NTS and where applicable used existing unit rates for cost comparison.

6 Options Considered

6.1.1 In 2023 we commissioned a Pre-FEED Study of Unit C to identify current asset condition, supportability and remnant life, with outputs including recommendations for further detailed assessment of potential required asset health interventions on Unit C.

6.1.2 [redacted] our SMEs produced survey scope documents to be used as the basis of the next stage of feasibility study. This included engagement [redacted] undertake detailed site surveys for current asset condition, remnant life, obsolescence / supportability, with the output being a draft report with justified recommendations for asset health interventions to meet the required extended operational life of Unit C.

6.1.3 [redacted]

6.1.4 The preferred scope at this stage has significantly expanded from the FOSR stage due to varying factors such as asset deterioration and current defects. These and other factors are further detailed in Section 8.

Options Considered Summary

6.1.5 In Tables 9 and 10 are the options considered for asset health interventions on Unit C and the justifications for the chosen interventions. This is further detailed in the Asset Health Survey Report (Appendix E).

Mechanical Assets	Do nothing	Minor Refurbishment	Major Refurbishment	Replacement
Pipework	High risk of corrosion, pipe support failure, and operational issues due to the dead leg which presents a risk from water accumulation and accelerated corrosion necessitating pressure reduction or isolation. Not viable for 25 years extended service life.	Moderate risk, but not a sustainable 25-year extended service life.	Low risk, ensuring a 25 - year lifespan. Best long-term 25 years extended service life. This is a balanced solution for an aging infrastructure, which ensures the system remains safe and reliable.	Excessive cost without added benefit. The current condition does not justify full replacement. Not cost-effective
Valves	Continued operation with 50+ year old valves increase the likelihood of failures (loss of compressor operation), leaks, and environmental hazards.	Not viable to address defects, obsolescence and environmental issues. Increases the likelihood of failures (loss of compressor operation), leaks, and environmental hazards. Repeat Capex investment leading to overall increase in whole life cost.	Not viable to address defects, obsolescence and environmental issues. Increases the likelihood of failures (loss of compressor operation), leaks, and environmental hazards. Repeat Capex investment leading to overall increase in whole life cost compared with replacement. Technically, old valves retrofitted with new electric actuators presents compatibility issues where satisfactory operation could not be guaranteed.	Most viable option. Full replacement of the valve system, alongside the electro-hydraulic actuator upgrade will ensure long-term operational reliability, compliance, and cost efficiency over the next 25 years.
Actuators	Not viable. High failure risk, increased downtime, and non-compliance with DSEAR, PSSR, and COMAH.	Temporary improvement but does not resolve reliability risks.	Short-term solution, does not address obsolescence or compliance.	Transition to electro-hydraulic actuators. This would eliminate process gas venting, enhance reliability, enhance safety and align with modern industry standards.
Lube Oil System	Not Viable as this system has extensive corrosion and coating degradation on pipework and critical wall thinning on bulk storage tank which must be addressed.	Moderate risk, but not a sustainable 25-year extended service life	Low risk, ensuring a 25 - year lifespan. This is a balanced solution for an aging infrastructure, which ensures the system remains safe and reliable.	Excessive cost without added benefit. The current condition does not justify full replacement. Not cost-effective.

Mechanical Assets	Do nothing	Minor Refurbishment	Major Refurbishment	Replacement
Fuel Gas Inlet System	Not viable as does not address several key issues with the fuel gas inlet pipework, including coating deterioration and deteriorated soil-to-air interface protection, which will lead to accelerated corrosion if not remediated.	Moderate risk, but not a sustainable 25-year extended service life.	Low risk, ensuring a 25 - year lifespan. Best long-term 25 years extended service life. This is a balanced solution for an aging infrastructure, which ensures the system remains safe and reliable.	Excessive cost without added benefit. The current condition does not justify full replacement. Not cost-effective

Table 9: Mechanical Asset Options and Recommendations

6.1.6 Electrical Sub-Asset intervention options are outlined in the Table 10 below and further detailed in the Asset Health Survey Report (Appendix E).

Electrical Assets	Do nothing	Minor Refurbishment	Major Refurbishment	Replacement
LV Switchboards	Not viable as does not satisfy absolute requirements of Legislation (Electricity at Work Regulations) or meet with BS EN 61439-1 2011 Low Voltage Switchgear and Control Gear.	Modifying internal components does not meet with BS EN 61439-1:2011 Low Voltage Switchgear and Control Gear.	Modifying internal components does not meet with BS EN 61439-1:2011 Low Voltage Switchgear and Control Gear.	Most viable option providing a guarantee of meeting the requirements of electrical standards and the desired reliability to minimise operational interruption for repairs for 25 years.
Motor Control Centre (MCC)	Not viable to meet with SCO96 safety, NGT standards or Legislation (Electricity at work Regulations).	Modifying internal components does not meet with BS EN 61439-1:2011 Low Voltage Switchgear and Control Gear.	Modifying internal components does not meet with BS EN 61439-1:2011 Low Voltage Switchgear and Control Gear.	Most viable option providing a guarantee of meeting the requirements of electrical standards and the desired reliability for trouble-free operations for 25 years
Distribution Boards	Not viable as the distribution boards are defective, obsolete with no spare parts available. They are also an integral part of the LV General Services board which must be replaced.	Not viable as LV board to be replaced (same reason as 'Do nothing' option).	Not viable as LV board to be replaced (same reason as 'Do nothing' option).	Most viable option to minimise operational interruption for repairs for 25 years. Lighting circuits DB s MCBs to be rated for LED circuits loads.
Motors	Not viable as local control stations are badly corroded presenting a safety and loss of control hazard. This does not support 25-year life extension of pump or vent fan drives.	Not recommended as this will necessitate multiple interventions over the 25-year operational life resulting in increased whole life cost compared with the Replacement option.	Not recommended as the cost of major overhaul of primarily small motors delivers only a small percentage saving compared with new motors and won't provide the required 25-year life intention.	Viable option, as new pumps and vent fans are recommended to minimise operational interruption for repairs operations for 25 years
Cables	Not viable as the MCC replacement will necessitate new cables.	Not applicable as cables cannot be repaired.	Not applicable as cables cannot be repaired.	Assuming that the MCC is replaced as per previous recommendation, this will necessitate new cables to the CAB C.
Lighting	Not viable as new LED fittings are recommended by /SP/EL/50 and BS Standards.	Not viable as existing fluorescent tubes are no longer manufactured. New LED lighting would require full system replacement for compatibility	Not viable (same reasons as minor refurbishment)	Most viable option to meet with latest Legislation and guarantee lighting performance for 25 years.
Gas Actuators	Not viable due to the high risk of mechanical failure, leakage, and inefficiencies due to aging valves. Increased emissions and compliance risks.	Not viable due to leaking obsolete valves where some are no longer supported. Does not address environmental and regulatory concerns associated with venting.	Not viable due to leaking obsolete valves where some are no longer supported. Does not address environmental and regulatory concerns associated with venting.	Utilising a more cost-effective electric actuation is typically prescribed. However, where operability and safety criticality require layers of protection beyond single point of failure, including but not limited to a necessity for systems to "fail safe", it is recommended to replace with **Electric Hydraulic actuation**. Whilst more expensive, this is due to its additional layer of protection should power loss occur and its functionality resulting in valves shutting should actuation completely fail.

Table 10: Electrical Asset Options and Recommendations

7 Preferred Option and Project Plan

7.1.1 As detailed in Tables 9 and 10, the proposed Electrical and Mechanical scope has been derived from the asset health surveys completed by our MWC and approved by our SMEs. The assessments outlined and the associated discounting and costing of options demonstrates that the most viable, cost effective and logical options to take forward are complete replacement of all electrical assets in scope and a mixture of refurbishment and replacement of mechanical assets in scope.

7.1.2 We recognise the significant CAPEX investment required to achieve this scope through the preferred option, however, this enables Unit C to achieve the robust, reliable and resilient long-term operation required as a backup unit.

7.1.3 Additionally, improvements are needed to comply with current safety regulations for hazards such as Arc Flash. The proposed scope represents the best investment option to continue to meet customer needs and maintain security of supply.

7.1.4 Focus is therefore on ensuring assets are procured which utilise sufficiently reliable available technology and which meet safety standards, with any investment delivered at the lowest overall cost.

Project Scope

7.1.5 The project scope, as established in the recommended interventions in Section 8, forms the basis of the volumes detailed in this section. The work scope includes:

- [redacted]

Asset Health Investment Codes and Project Timeline

7.1.6 We propose to use the following new Investment Codes aligned with our re-opener request to apportion out the cost at delivery stage as shown in Table 11 below. This includes various types, sizes and lengths of power and instrumentation cable required for the re-installation and commissioning of Unit C.

S/N	Name	Investment Code	UID	Delivery Theme
[redacted]				

Table 11: New Unit C Asset Health Investment Codes

Unit C Sub-Asset Replacement Volumes.

7.1.7 Table 12 details the key volumes of sub-assets proposed for replacement on Unit C. The table also identifies the duplication of volumes between this re-opener and RIIO-GT3 Business Plan.

7.1.8 The agreed approach is to deliver the duplications through the MCPD project due to the costing being more recent and market tested, and the cost and volumes removed from the RIIO-GT3 Business Plan.

Electrical Sub-Asset Description	Quantity	Investment Code	RIIO-GT3 Business Plan Interface
[redacted]			

Mechanical Sub-Asset Description	Quantity	Investment Code	RIIO-GT3 Business Plan Interface
[redacted]			

Mechanical Sub-Asset Description	Quantity	Investment Code	RIIO-GT3 Business Plan Interface
[redacted]			

Table 12: Proposed Unit C Asset Health Replacement Volumes

Project Timescales

7.1.9 The project was sanctioned at NDP500 Stage 4.2 in April 2022 and detailed asset health surveys were completed in November 2024. The project progressed to ND500 Stage 4.4 in June 2025 to ratify the outcome of the asset health scoping, cost estimation (+/- 15%) and delivery programme.

7.1.10 Table 13 and 14 below outline the milestones and indicative timeline for delivering the project across RIIO-T2 and RIIO-GT3. An indicative delivery programme is included in Appendix D and the outage plan in Appendix F.

	Activity Name	Indicative Completion Dates
[redacted]		

Table 13: Huntingdon Asset Health Project Indicative Milestones

FY27	FY28	FY29	FY30
[redacted]			

Table 14: Huntingdon Asset Health Project Timeline

8 Cost Build up and Estimation Methodology

8.1.1 [redacted] Funding granted was to undertake feasibility, a conceptual study and develop the options to determine the preferred solution. The FOSR spend to date has been quantified within the Huntingdon Cost Book (Appendix A).

8.1.2 To ensure robustness of costs, we employed the use of Designers / Main Works Contractors (MWCs) to validate scope, understand engineering challenges, and build an externally priced estimate reflecting current market costs.

8.1.3 [redacted]

8.1.4 The cost estimates are considered tendered prices i.e. they are based on bottom-up approach provided by an experienced MWC, using tendered pricing from designers, equipment and material suppliers, and internal estimates for people, plant and machinery. The contractor's estimate confidence level is further detailed in the Contractor Cost Methodology Report (Appendix H).

Estimating Uncertainty (EU)

8.1.5 In line with the Infrastructure and Projects Authority (IPA) cost estimating framework, the cost estimate has been structured around the fundamental equation: Base Estimate + Estimating Uncertainty + Risk = Anticipated Final Cost. The EU range selected was based on a Class estimate maturity, with a range of +14%/-5% applied. Our Cost and Risk Report (Appendix F) further details the methodology for calculating the EU on this project.

8.1.6 Our Cost and Risk Report (Appendix F) outlines the cost and risk methodology used to establish a comprehensive and transparent framework for the project's financial planning and risk management. It delineates the systematic approach used to develop our cost estimates for this project.

Efficient Cost

8.1.7 The MWC produced detailed asset health surveys, which were conducted through the last stage of feasibility. Outputs from MWC, including cost estimation and delivery programme are included within our preferred option.

8.1.8 Following internal review of the MWC surveys reports and recommendations, the preferred option scope was confirmed. For some sub assets such as pipework, the initial recommended scope was revised from minor to major refurbishment due to the condition of the asset and the benefit of the initial recommendation being deemed insufficient.

8.1.9 Based on the confirmed scope, the MWC produced a bottom-up cost estimate including quotations from the supply chain for detailed engineering, equipment and materials purchase, and internal estimation for labour and plant for the Construction and Commissioning phases.

8.1.10 [redacted] activity pricing schedule provided by the MWC has undergone a cost assurance exercise. Key activities included cross checking Material Take-off (MTO) quantities and rates for materials, reviewing durations and resources for both construction activities and design phases to ensure alignment with both the programme of works and project requirements.

8.1.11 Specifications of fittings and pipework to be procured by the MWC have also been checked as suitable. To ensure that all costs have been allowed for by the MWC, a Document Review Sheet (DRS) was produced by NGT and issued to the MWC highlighting areas of concern or where clarification was required. This has resulted in a revised activity pricing schedule incorporating the comments and queries raised to clarify points such as granularity of costs, scope limits and resource allocations.

8.1.12 Through this additional information, durations of activities and detail of allowances were able to be checked against scope activities. The resource forecast provided by the MWC provides additional cost assurance that sufficient project management allowances have been made. Where quantity errors have been found, these have been adjusted/reduced in alignment with resource durations. Rates have also been used from MCPD new build Short Schedule of Cost Components (SSCC), an existing set of contractor rates.

8.1.13 All quotes from the MWC have been included in the Contractor Cost Methodology Report (Appendix H) including a

resource phasing forecast.

8.1.14 NGT costs (our staff and operations resourcing) required to support successful project delivery has been built-up using the Contractor's delivery programme. This programme defines when the key project delivery milestones will take place and as such, we can determine our optimum / efficient resources required to support each stage. Resourcing has been identified through several key sources:

- Assessment of governing specifications and standards (e.g. BP/133G) defines core project delivery roles and responsibilities,
- Cross comparison against the resources utilised on similar asset health projects [redacted] terminal asset health projects),
- Lessons learnt from historic delivery projects ([redacted] terminal asset health projects).
- Engagement with various disciplines within across our core departments (Asset, System Operator, Construction and Operations).

8.1.15 Staff utilisation throughout key project phases (detailed engineering, construction, commissioning, documentation handover/closure) was determined by the interrogation of:

- The Contractor's programme for Formal Process Safety Assessment (FPSA) workshops such as HAZOPs (Hazard and Operability Study), HAZCON (Hazard in Construction) etc. which are resource intensive particularly for engineering subject matter experts.
- The Contractor's construction programme which identifies the number of work areas to be supervised, the number of work crews proposed by the Contractor, the presence of any weekend working (the Contractor will work a 10-day rotation). This helped us determine the requirement for more than one project supervisor or safety advisor.

8.1.16 Supporting narrative on NGT direct roles and their project responsibilities are contained within Appendix A. Please refer to the NGT Cost tab of the Huntingdon Compressor Emissions cost book for more granular cost detail.

Contracting Strategy

8.1.17 We have packaged the works associated with this submission for asset health works on Unit C [redacted]

8.1.18 This contract type was selected, following market consultation with [redacted] enable early collaboration and engagement with the Contractor to prioritise scope definition and cost estimate development ahead of the re-opener submission. This ECI approach reduces risk, enhances collaboration, and ensures timely delivery. Bringing the contractor into the early design and planning phases allows for their input ahead of construction which contributes to cost efficiencies through design optimisation, constructability, risk management, and stakeholder alignment.

8.1.19 The ECI model was adopted in preference to traditional procurement methods such as competitive tender on a design and build basis, which limit collaboration and hinder innovation during early stages of project development, which often leads to changes late in the design process with significant increase in cost and project delays.

8.1.20 Stage 1 involved conducting the survey, establishing the project scope and conducting the cost assurance on a cost reimbursable basis forming the basis of this submission.

8.1.21 Stage 2 will involve a tender with the same MWC for the detailed engineering and delivery phase on either an Option A firm price or Option C target price basis. Stage 2 will be divided into two phases. Phase 1 will be detailed engineering and long lead procurement. At the completion of phase 1, the contractor will reconfirm the cost for phase two, construction. commissioning and close out. Should phase two costs exceed agreed allowances, we have the option to spot tender phase 2 works.

Huntingdon Re-opener cost movement from FOSR

8.1.22 In the FOSR submission we identified and evaluated a range of investment solutions to achieve MCPD compressor emissions compliance. We proposed a broad range of technological, operational and commercial solutions to derive the shortlist of options and cost estimate to an accuracy of +/- 30%. The main purpose of the estimate of circa [redacted] was to support the commercial evaluation and comparison of the proposed options.

8.1.23 Asset health costs estimated at FOSR stage were based on unit costs agreed as part of our RIIO-T2 business plans where available.

8.1.24 Since then, a combination of findings from asset health surveys and defects raised (Table 17) have contributed to significant variance in costs when compared to the estimate produced by the Contractor for this re-opener. These include:

8.1.25 **Civils and Painting** – This element of scope was not included in FOSR submission but introduced post FOSR asset health surveys to confirm and validate scope between the MWC and our SMEs.

8.1.26 **Revised Scope** – Post survey reviews between SMEs and the MWC to finalise scope have revealed a need to revise scope assumptions made at FOSR stage to address asset health issues on sub-assets such as valves and actuators, where the initial assumption for major refurbishment has been upgraded to replacement due to the condition of the asset and need to deliver a solution that fully addresses engineering concerns at the best value to the consumers.

8.1.27 **New Scope** – Post FOSR surveys have confirmed new essential scope. Most significant is the replacement of the valves. We have assessed the deliverability of the new scope described and ensured that the related programme of works is in alignment with the RIIO-GT3 plan. Chapter 9 provides further details on deliverability.

8.1.28 **Materials** – Material costs have increased overall due to new scope compared to FOSR and moving costs out of NGT direct procured to the MWC costs to ensure that accountability and risk management is clear.

8.1.29 **Main Works Contractor costs** – These costs have increased overall as the revalidation exercise has taken place. Costs for the works in re-opener have now been programmed after a detailed deliverability of valve replacement works was undertaken looking at what can be achieved across the RIIO-T2 and RIIO-GT3 period. Subsequently, costs through extension of the works have increased the overall cost. MWC costs have also increased due to new scope for pipework refurbishment.

8.1.30 **Direct Company costs** – Direct costs have increased in line with the revised duration of works across RIIO- GT3 and coincide with the corresponding increase in MWC costs for the same reason.

8.1.31 **Engineering Design** – Conceptual engineering for the defined scope of works for mechanical and electrical asset health interventions have been adjusted in line with works that have already been completed or reassigned to other RIIO-GT3 portfolios.

8.1.32 **Project Management** – Overall duration of the project has increased from the original FOSR submission as the delivery programme is now matured, with phasing of works over 2 outages in consecutive years confirmed following a deliverability assessment.

8.1.33 **Risk and contingency** – The overall risk at [redacted] and within the appropriate risk coverage for this scope of work. The additional level of detailed work undertaken allowed more robust updates to be made to the Quantitative Risk Analysis (QRA) which ultimately drives this cost element.

8.1.34 Whilst overall costs have increased significantly, it should be noted that several factors such as market price increases, appropriate risk allocation, revised intervention categories and the addition of substantial new scope due to asset condition have reasonably contributed to the current cost position. This is further detailed in the Cost and Risk Report (Appendix F).

8.1.35 This option is developed from the FOSR, where asset health is required to ensure that the station can remain optimally operational and provide the resilience to enable us to deliver gas to our customers in volumes and at pressures they require.

8.1.36 Table 15 provides a breakdown of the final costs for the project split by several categories.

	Cost Category	Costs (£m) 2018/19 Price Base	% of EAC
[redacted]			

	Cost Category	Costs (£m) 2018/19 Price Base	% of EAC
[redacted]			

Table 15: Preferred Option Final Costs

Key Business Risks and Deliverability Challenges

8.1.37 NGT's risk methodology is provided within Appendix F (NGT Cost and Risk Report). This document outlines the processes undertaken to understand and quantify the project's risk exposure. It comprises the steps from the initial, collaborative risk identification workshops and subsequent qualitative and quantitative risk assessments conducted prior to tendering and submission of costs for assessment by Ofgem. It illustrates the risk process and describes its outputs, ultimately informing the steps involved in the calculation of the risk contingency applied for within this submission by NGT moving into the delivery phase.

8.1.38 Our risk contingency supplements Contractor risks i.e. there is clear delineation of risk ownership between NGT and the Contractor, as documented within the NGT Cost and Risk Methodology. [redacted]

8.1.39 The requested risk allowance is appropriate for this complex, multi-year capital investment project and reflects efficiencies identified through NGT and Contractor, directly incorporating lessons learned.

8.1.40 NGT Cost and Risk Report (Appendix F) outlines the cost and risk methodology used to establish a comprehensive and transparent framework for the project's financial planning and risk management. It delineates the systematic approach used to develop NGT's cost estimates for Huntingdon Asset Health MCPD project.

8.1.41 Table 16 summarises the key three risks for asset health scope. The complete risk register, contingency together with the risk profiles, probability of occurrence and three-point estimates of cost and/or time impacts are presented in the Risk Register within the Huntingdon Compressor Emissions Cost book (Appendix A).

[redacted]

Table 16: Top 3 Identified Risks

8.1.42 Outages have been secured for delivery of the Unit C asset health, with close engagement required with NGT System Operations to adapt our planning to meet both changes in operational requirements and ensure successful project delivery inside agreed timescales.

8.1.43 The delivery programme is based on level 3 programmes from our experienced MWC, combined with our internally estimated timescales based on similar projects already delivered, and confirmed outages.

8.1.44 The following challenges are foreseen with other activities and interactions at the station which have been captured in our planning assumptions:

- Operationally critical maintenance activities – Maintenance activities that are undertaken at Huntingdon on fixed intervals driven by legislative requirements such as Pipeline Safety Regulations 1996 (PSR) and Pressure Systems Safety Regulations 2000 (PSSR) were fixed in the schedule as they cannot be moved.
- [redacted] Ongoing engagement with the CSRP team will be undertaken to adapt to any changes in delivery timescales or conflicts.
- All associated civils works require additional planning, temporary works, and a more complex strategy.
- All civils work will be conducted in accordance with all relevant safety standards. The dense population of buried services, plant and equipment leads to above ground complications with heavy machinery.
- Emerging scope leading to additional works required.

8.1.45 Despite the challenges detailed above, we have completed a series of deliverability assessments to confirm the scope is deliverable within the planned program. See Table 14 for outline milestones and Appendix D for the Huntingdon MCPD asset health indicative delivery program for further details.

8.1.46 Deliverability has also been aligned to the RIIO-GT3 plan, and other adjacent work and customer outages.

Opportunities

8.1.47 In addition to identifying and implementing effective risk mitigation strategies, we recognise the importance of proactively identifying and capitalising on opportunities to enhance project value and achieve optimal outcomes.

8.1.48 We are committed to a strategic approach that prioritises the exploration and realisation of potential efficiencies, innovations and synergistic collaborations on the Huntingdon MCPD project. This approach is designed to ensure that the project not only meets its core objectives but also maximises its potential to deliver long-term benefits for our customers and consumers.

8.1.49 Integral to our opportunity realisation strategy is the application of value engineering principles. We will regularly review project components to identify cost-effective alternatives that could maintain or enhance functionality and performance of our compressor fleet throughout the lifecycle of the projects and continuously pursue emerging opportunities including those identified through value engineering exercises. By following this approach, we aim to translate identified opportunities into tangible benefits, contributing to the overall success of the project.

What the investment seeks to achieve

8.1.50 This investment aims to secure funding to deliver asset health interventions on Huntingdon's Unit C to support the agreed derogation under MCPD from 2030. To achieve this, NGT is working with its MWC contractor to define the optimal scope, volume and cost to deliver this output within the RIIO-T2 and RIIO-GT3 regulatory period and in line with the station's outage windows. This will:

- Ensure Unit C can comply with MCPD legislative requirements via derogation.
- Ensure Unit C can effectively operate and perform its function when required to, out to 2050.
- Ensure Unit C is fully supportable such that any unexpected defects can be remediated without significant impact on the availability of the station.
- Safely remove/or replace components that are no longer required, to manage overall whole life cost and risk.

8.1.51 Should the proposed interventions not be performed, an increasing defect count would correlate with an increased probability of unplanned unit operational stand down.

8.1.52 Huntingdon's central location on the network positions it to provide overall operational flexibility for the NTS. Therefore, secure, flexible and reliable solutions need to be implemented at the station to meet MCPD emissions legislation and aligns with our 1-in-20 peak demand obligations. It is essential that the required level of site reliability and availability is achieved. The completion of these asset health intervention supports this outcome.

How will we understand if the project has been successful?

8.1.53 The project will be deemed successful when all asset health works are completed, the unit is returned to service and demonstrates reliable service as required. Furthermore, once the scope has been delivered, the asset will comply to the relevant technical specifications, safety, and engineering standards.

8.1.54 The delivery of this project will ensure the unit continues being available, is maintainable and operational until 2050, ensuring we continue delivering gas to customers and end consumers. The life extension will ultimately support network resilience and save customers' money by potentially preventing site shut down and network constraints when the gas could not be delivered where intended.

8.1.55 Additionally, our Management Procedure (T/PM/G/35) incorporates the philosophy and general principles outlined in the Institution of Gas Engineers & Managers (IGEM) standard IGEM/GL/5 Edition 2 'Managing new works, modifications and repairs' and serves to adopt its principles. Adherence to this will be demonstrated prior to the issuing of a commissioning of replacement valves and electrical panels and the asset being handed back to the operator.

Spend Boundaries

8.1.56 This paper only covers asset health interventions on Unit C, at Huntingdon Compressor station and is aligned with the agreed FOSR preferred option for compliance with MCPD. The proposed investments only cover agreed defects and improvements following asset health survey reviews conducted by our SMEs and the MWC.

8.1.57 The scope covered under this re-opener submission has been assessed against remaining works in RIIO-T2 and our

RIIO-GT3 plan to ensure there are no duplication of scope and volumes. This is highlighted in Table 12 above and further detailed in Section 9.

9 Interaction with Asset Management Plan

9.1.1 During the early development stage of the FOSR, we identified a potential interaction between the Huntingdon MCPD scope of work and the broader RIIO-T2 and RIIO-GT3 Business Plans.

9.1.2 Since then, detailed surveys have been conducted and most of the work will be conducted through MCPD. The primary interaction involves valve and filter sub-assets. An alignment process ensures that boundaries are clearly defined and prevents double-counting of the same scope or interventions.

9.1.3 Table 17 shows a summary scope assessment of Huntingdon MCPD and the Asset Management Plan. The Emissions FOSR scope was determined following a Remnant Life Survey (RLS) of Unit C.

Table 17: Huntingdon Unit C MCPD Vs AMP Works Assessment

10 Conclusion

10.1.1 This document outlines the scope of the Asset Health Re-opener submission for Huntington, along with the associated funding request. The majority of the requested funding relates to investments required to meet short to medium term needs, spanning over two regulatory periods. It also sets out our proposed Price Control Deliverable in line with Ofgem's final approved option.

10.1.2 Section 8 provides a high-level overview of the cost estimation methodology applied, including the principles and assumptions that inform our approach. This section also outlines our risk management framework and identifies key risks associated with delivery of this proposed investment.

10.1.3 The project's agreed scope and cost have been assured for efficiency. The scope has been assessed against the current electrical and mechanical standards, while the costs have been assured by benchmarking against similar projects delivered.

10.1.4 We maintain our commitment to proactive risk management and the identification of strategic opportunities to support the efficient delivery of value-driven outcomes. Given the critical nature of the assets and their operational role, timely delivery of the projects outlined in this submission is essential to mitigate significant safety, environmental, operational and financial risks.

10.1.5 This submission reflects our responsibility to maintain safe, reliable, and cost-effective service delivery, aligned with the regulatory expectations and long-term consumer outcomes.

11.1.1 Our total funding request within this re-opener submission is [redacted] with the cost book for the submission enclosed in Appendix A.

11 Appendices

Document	Filename
Appendix A	NGT Huntingdon Compressor Emissions - Cost Book
Appendix B	Assurance Letter
Appendix C	Mapping to Ofgem Requirements
Appendix D	Huntingdon Asset Health Delivery Programme
Appendix E	Huntingdon Asset Health Survey Report
Appendix F	Huntingdon NGT Cost and Risk Report
Appendix G	Peterborough and Huntingdon Emissions Final Option Selection Report (FOSR)
Appendix H	Huntingdon Contractor Cost Methodology Report
Appendix I	Huntingdon Unit C Defects List
Appendix J	Huntingdon Outage Plan
Appendix K	NGT Fleet RAM Study Report

12 Glossary

Glossary	
CSRP	**Control System Restricted Performance**: Technology that restricts the performance of a gas-driven compressor to limit NOx emissions.
CDS	Conceptual Design Study
COMAH	Control of Major Accident Hazards (COMAH) Regulations 2015.
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations 2002
EAC	**Estimated Cost at Completion:** A value expressed in money and/or hours to represent the projected final costs of work when completed.
ECI	Early Contractor Involvement
EJP	Engineering Justification Paper
EPC	Engineering Procurement and Construction
FES	**Future Energy Scenarios:** An annual industry-wide consultation process encompassing questionnaires, workshops, meetings and seminars to seek feedback on latest scenarios and shape future scenario work. The Future Energy Scenarios document is produced annually by National Grid ESO and contains their latest scenarios.
FOSR	Final Option Selection Report
GS(M)R	**Gas Safety (Management) Regulations:** The Gas Safety (Management) Regulations 1996 (GS(M)R) apply to the conveyance of natural gas (methane) through pipes to domestic and other consumers
HSE	**Health and Safety Executive**
IPA	**Infrastructure and Projects Authority**
LNG	Liquified Natural Gas, Natural gas that has been cooled to a liquid state (around -162°C) and either stored and/or transported in this liquid form.
LAV	Locally Actuated Valves
MWC	Main Works Contractor
DSEAR	Dangerous Substance and Explosive Atmospheres Regulations 2002
(G)NDP	**Network Development Process:** The process by which NGT identifies and implements physical investment on the NTS.
NEC	New Engineering Contract
NGT	National Gas Transmission
NTS	**National Transmission System:** The high-pressure system consisting of Terminals, compressor stations, pipeline systems and offtakes. Designed to operate at pressures up to 94 barg. NTS pipelines transport gas from Terminals to NTS offtakes.

Glossary	
OEM	**Original Equipment Manufacturer**
Ofgem	**Office of Gas and Electricity Markets:** The regulatory agency responsible for regulating Great Britain's gas and electricity markets.
PV	**Process Valves**
PSSR	Pressure Systems Safety Regulations 2000
RAM	**Reliability Availability Maintainability**
Re-opener	Re-openers are a type of RIIO uncertainty mechanism. Depending on their design, they allow Ofgem to adjust a licensee's allowances (in some cases up and in some cases down), outputs and delivery dates in response to changing circumstances during the price control period.
RIIO	**Revenue = Incentives + Innovation + Outputs**: RIIO-T2 is the second transmission price control review to reflect the framework; it sets out what the transmission network companies are expected to deliver and details of the regulatory framework that supports both effective and efficient delivery for energy consumers.
ROV	**Remote Operation Valves**
SOL	**Safe Operating Limit**
Uncertainty Mechanism	Uncertainty mechanisms exist to allow price control arrangements to respond to change. They protect both end consumers and licensees from unforecastable risk or changes in circumstances.
UKCS	**United Kingdom Continental Shelf:** The UK Continental Shelf (UKCS) is the region of waters surrounding the United Kingdom, in which the country has mineral rights. The UK continental shelf includes parts of the North Sea, the North Atlantic, the Irish Sea and the English Channel; the area includes large resources of oil and gas.
UID	Unique Identifier

Contact:

[redacted]

nationalgas.com

national gas transmission