national gas transmission

St Fergus Compressor Emissions Re-opener: Asset Health HV Transformers

Engineering Justification Paper
December 2025

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Official Sensitive Commercial

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Version/revision number	Date of issue	Notes
0.1	November- 25	NGT First Draft (without cost estimates)
0.2	December- 25	NGT Second Draft (with cost estimates)
1.0	December- 25	Ofgem Submission

Contents

1 Project Summary Table

1.1.1 The Table 1 below sets out key information about the HV Transformer Replacement project. All figures represented in this EJP are in 18/19 price base.

Table 1: Summary table for HV Transformer

[1] For RIIO-T2 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). For RIIO-GT3 and RIIO-GT4 our funding request under CEPOt includes direct and indirect cost.

2 Executive Summary

2.1.1 National Gas Transmission (NGT) is seeking [redacted] 2018/19) funding under the RIIO-T2 Compressor Emissions Re-opener and Price Control Deliverable Uncertainty Mechanism to replace six high-voltage (HV) Transformers and their associated works at the St Fergus Gas Terminal. This request is made in accordance with Licence Special Condition 3.11 and Ofgem's Re-opener Guidance. It builds on the previous submissions: St Fergus Site Strategy June 2023, NGT AH2 St Fergus HV Transformers September 2023 and the NGT St Fergus HV Transformers Addendum June 2024.

2.1.2 The St Fergus Terminal is critical to UK energy security, processing between 25% and 50% of national gas supply. As an upper-tier COMAH site, it is subject to stringent safety and environmental regulation. Much of its infrastructure has been in continuous operation for over 45 years and is now beyond its design life.

2.1.3 Six of the eight HV transformers serving the terminal are severely degraded, with condition assessments confirming corrosion, oil leaks, and electrical failures. These issues have left the terminal reliant on short-term contingency measures. Continued operation without replacement poses significant safety, reliability, and environmental risks. In addition, the assets are non-compliant with current standards, further underscoring the need for intervention.

2.1.4 This proposal aligns with NGT's short-term strategy to maintain operational capability through 2030. The scope includes replacing the six defective HV transformers and associated works to ensure compliance and resilience. The project is at an advanced stage of development, with surveys completed and cost confidence within ±15%.

2.1.5 In its December 2024 decision on the Asset Health Re-opener application, Ofgem agreed the need and option for this investment and further confirmed that NGT may submit an application for efficiently incurred costs via the Compressor Emissions Re-opener. This submission reflects that decision and aligns with the short-term strategy (Appendix D of the Cover Note) for St Fergus, which confirmed the requirement for investment in High Voltage Transformers and was supported by the engineering justification in Appendix A of our previous submission.

2.1.6 Since the June 2024 addendum, delivery timescales have been revised following detailed design reviews and supply chain engagement. While the addendum anticipated installing the MTB, Plant 2 and Plant 1 transformers within the 2025 construction window, two material events necessitated a phased approach and delayed construction to 2027 with project completion by February 2028. NGT provides further details on this in section 7.6 below.

2.1.7 A dedicated Programme section (Section 7.6) sets out the re-baselined milestones, critical-path dependencies (including transformer manufacture lead times and safety approvals), and mitigations now in place to safeguard delivery.

2.1.8 All figures in this document are in 2018/19 prices except where otherwise stated.

3 Introduction and Request Summary

3.1.1 This EJP builds on the previous submitted application, maintaining the established needs case, scope of works and the optioneering process set out in our initial submission for this investment.

3.1.2 Since the original EJP submission in June 2023 Appendix A, NGT have undertaken a conceptual Front-End Engineering Design(FEED) study with an external consultant [redacted] to develop a conceptual design and cost estimate. The FEED findings were reviewed with internal electrical Subject Matter Experts (SME)s and St Fergus terminal operators and personnel. This work validated the scope for Transformer replacements and was summarised in the formal addendum submitted to Ofgem in June 2024 (Appendix B).

3.1.3 Following consultation with Ofgem, this project was deemed to fall outside of the scope of Special Condition 3.14 Asset health Re-opener (AHt). However, Ofgem confirmed the validity of the needs case, agreed that the correct option selection process had been followed, and endorsed the preferred option to ensure continued, resilient provision of electrical supply by replacing all six defective transformers. In its Decision on Asset health Re-opener Applications (January 2023 and June 2023), Ofgem subsequently directed NGT to apply for efficiently incurred costs under Special Condition 3.11 Compressor Emissions (this submission).

3.1.4 Since the RIIO-T2 Final Determinations, we have adopted a two-phase approach for St Fergus: a short-term strategy focused on asset health and operational certainty to 2030, and a long-term strategy to deliver the enduring terminal solution beyond 2030.

3.1.5 The short-term strategy, as outlined in June 2023 submission, confirms the minimum compression requirements across Plants 1 and 2 and underpins investment decisions to maintain reliable operation to 2030.

3.1.6 This approach supports rationalising compression to four [redacted] (previously referred to as [redacted] units (1A, 1B, 1D, 2B) and informs the need for transformer replacements for these units, ensuring alignment with the long-term terminal objectives.

3.1.7 The investment outlined in this justification paper concerns transformers which are used to provide low voltage supply (415V) by stepping down high voltage (11kV) supplied from the nearby [redacted]

3.1.8 The six transformers serving the Main Terminal Building (MTB), Plant 1 and Plant 2 were installed during the original construction in 1977. Each area was designed to have two transformers (duty and standby).

3.1.9 In the June 2023 submission, NGT provided details of the legacy transformers operating well beyond their 25-year design life. Inspections have identified multiple defects. Beyond concerns on the condition of the assets, the legacy transformers fail to meet the current industrial standards and regulatory requirements. This non-compliance exposes the terminal to safety, operational, and environmental risks, as detailed in Section 4 and Appendix H of the June 2023 EJP.

3.1.10 Despite the short-term remedial measures evidenced in Table 4, the condition of the assets continues to deteriorate. Widespread corrosion and oil leaks persist across multiple units. Furthermore, in October 2024, Plant 2 Transformer 2 (T2) suffered an irreparable electrical failure, leaving Plants 1 and 2 dependents on backup systems. Structural degradation is evident across multiple units, compounding risk and limiting the effectiveness of interim repairs. The interdependency between these plants and contingency arrangements is explained in Section 7 of this document. Comprehensive condition assessments and failure history are detailed in Section 4 and Appendix J of the June 2023 EJP.

3.1.11 The current backup power provision relies on gas turbine standby generators for Plants 1 and 2 (installed in 1977) and a diesel generator for the MTB (installed in 1995). These generators were never intended or designed for prolonged operation and have historically seen minimal use, creating significant uncertainty about their reliability under extended use.

3.1.12 This dependency on aging standby generation introduces material security-of-supply risks for an upper tier COMAH Terminal. While standby generators are scheduled for replacement under RIIO-GT3, they remain a contingency measure and cannot mitigate the fundamental risk posed by deteriorating transformers. Prolonged reliance on backup systems is neither sustainable nor compliant for an upper tier COMAH Terminal. Section 4 of the June 2023 EJP sets out the resilience and compliance implications of this risk.

3.1.13 The June 2024 Addendum proposed installing the replacement transformers within Plant 1 and Plant 2 utilising the existing transformer bays. The latest revision of [redacted] (Appendix G) revised this position and indicates that the existing bays may not be suitable to support the additional loads. NGT investigated the options provided in the report and provide detailed cost within the cost book (Appendix C).

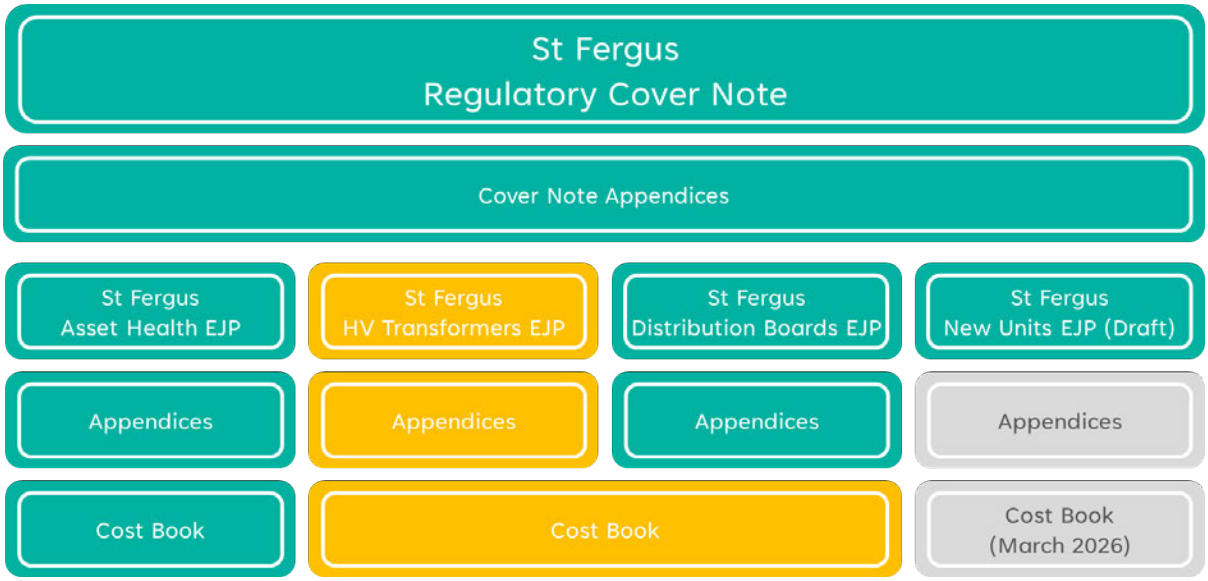

Figure 1: St Fergus MCPD Reopener Submission Pack

3.2 Funding Request Summary

3.2.1 This submission is made in accordance with Special Condition 3.11, Part D and requests to modify the outputs, delivery dates and allowances in Appendix 2 of the Gas Transporter Licence (the Licence), which are detailed in Tables 4 and 5. Our total funding request (CEPOt) to deliver the required HV Transformer works at St Fergus is [redacted] Ofgem are invited to assess and approve our cost proposal for the St Fergus Asset Health works in line with Special Condition 3.11, Part F.

3.2.2 Table 2 below sets out the total funding request to deliver the HV Transformer scope at St Fergus. Further details are included within the cost book (Appendix C). For RIIO-T2 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). For RIIO-GT3 our funding request under CEPOt includes direct and indirect cost.

Table 2: Current Estimated RIIO-T2 / RIIO-GT3 spend profile and funding request (£m, 2018/19)

[redacted]

3.3 Price Control Deliverable

3.3.1 Table 3 provides a summary of the proposed Price Control Deliverables (PCD) Output associated with the delivery of the delivery of the proposed Re-opener scope for the HV Transformer at St Fergus.

4 Equipment Summary

4.1.1 The transformers are fundamental to the St Fergus electricity supply, stepping down 11kV incoming supply to a three-phase 415V LV distribution that serves LV and MCCs across the Main Terminal Building (MTB), Plant 1, Plant 2 and Plant 3.

4.1.2 At St Fergus, two 11kV feeds from the [redacted] substation interface with NGT's 11kV switchboard, and power is routed via feeder breakers to six 11 kV/415 V transformers that provide area-based supply and redundancy (two per MTB, Plant 1, and Plant 2; Plant 3 has two later units installed in 2008).

4.1.3 The paired transformer configuration per area is designed to maintain continuity during planned works or fault isolation supplying either side of the LV boards through interlocked incomers and bus-section arrangements and, where needed, standby generation can be sequenced to provide temporary supply, including the crossover link between Plant 1 and Plant 2 right-hand sections to enhance flexibility. This arrangement enables maintenance and isolation without a full loss of incoming supply, supporting terminal resilience and operational continuity

4.1.4 Although two previously isolated units were temporarily returned to service, P2/T2 failed irreparably in October 2024. P1/T1 and P2/T2 are now out of service and beyond repair, leaving Plant 1 and Plant 2 on a single transformer and increasing exposure to standby generation risks. The legacy units are non-compliant with current standards and expectations (e.g., BS EN 60076-2018, EcoDesign Tier 2, and NGT T/SP/EL/50 containment/bunding requirements), and failure could carry safety, environmental, and security-of-supply impacts if prolonged generator operation is required

4.1.5 The Equipment in scope of this submission focuses on the six HV transformers which supply the MTB, Plant 1 and Plant 2.

4.1.6 As shown in Figure 2, the terminal is electrically divided into four main areas which are:

- Main terminal building (MTB) – shown in blue
- Plant 1 – shown in green
- Plant 2 – shown in yellow
- Plant 3 – shown in red

4.1.7 Table 4 provides a breakdown of transformer installations, including location, installation year, configuration, identified issues, status and interim actions currently in place to manage risk until replacement.

Table 4: Transformer Condition and Status Summary

Transformer	Location	Installed	Configuration	Issue	Status	Interim Action
Plant 1- T1	Plant 1	1977	Duty	Severe corrosion, oil loss	Out of service	Isolated
Plant 1- T2	Plant 1	1977	Standby	Heavily corroded	Noticeable lean	In service (reliant on gas turbine generator for backup)
Plant 2- T1	Plant 2	1977	Duty	Heavily corroded	Poor condition with parts corroded, NGT have applied temporary painting measures.	In service (reliant on gas turbine generator for backup)
Plant 2- T2	Plant 2	1977	Standby	Electrical failure	Beyond repair and isolated.	Failed October 2024
BGC- T1	MTB	1977	Duty	Corrosion	Poor condition with parts corroded, NGT have applied temporary painting measures.	In service short-term
BGC- T2	MTB	1977	Standby	Corrosion	Poor condition with parts corroded, NGT have applied temporary painting measures.	In service (reliant on diesel generator for backup)

4.1.8 [redacted] (highlighted in Figure 3 below) located within the National Gas terminal perimeter, provides the primary power supply via two 11kV switchgear [redacted] is relocating this substation outside the terminal boundary and installing modern switchgear compliant with current standards and HSE regulations. This change requires interface alignment with NGT terminal systems and reinforces the need to replace aging transformers to ensure compatibility and maintain security of supply (full electrical configuration and interface details are provided in Section 3 of the June 2023 EJP).

4.1.9 Details of the primary and secondary distribution to the six transformers requiring replacement can be found in the Equipment summary of the first submission (Appendix A)

[redacted]

5 Problem Statement

5.1.1 The High Voltage transformers supplying the Main Terminal Building, Plant 1 and Plant 2 at St Fergus have exceeded their intended design life and remain high-risk assets despite temporary measures and minor repairs. Recent condition assessments confirm significant deterioration, and the Operational Risk Assessment and Maintenance (ORAM) score for these assets is 8/25, indicating elevated risk to reliability and compliance. See Appendix D– HV Transformers risk score.

5.1.2 Inspections on the HV transformers have identified severe corrosion, oil leaks, and electrical failures, leaving the terminal reliant on short-term measures such as standby generators. These transformers also fail to meet current industrial standards, posing safety, operational, and environmental risks. We expand on the investment drivers for this replacement in Table 5 below.

5.1.3 Additionally, to ensure sound engineering practice, NGT completed an optioneering exercise with internal civil SMEs for the MTB transformers roof replacement. To ensure that the appropriate conditions are applied for these new transformers – noting that the MTB transformers are dry cast resin requiring containment in air and watertight area.

5.1.4 The drivers for this investment remains unchanged:

Table 5: Problem Statement and Key Investment Drivers

Driver	Summary
Asset Deterioration	Severe corrosion and oil leakage pose safety and environmental risk; interim repairs do not address ageing of internal components.
Standards & Legislation	Transformers do not meet current standards: BS EN 60076-2018, COMAH Regulations and National Gas Electrical Specification T/SP/EL/50
Reliability & Resilience	Units are vulnerable to failure, increasing reliance on aged standby generators unsuitable for prolonged operation.
Safety &Environmental Risk	Corrosion–related failures have caused catastrophic incidents elsewhere; oil leakage could contaminate watercourse. Additionally, oil filled equipment failure can eject burning oil and gas, posing severe fire risk, potential fatalities, and major asset damage.
Financial Impact	Extended generator use incurs higher operating costs and breaches UKETS permit thresholds.

5.2 Problem Example

5.2.1 Independent Terminal inspections by [redacted] (Appendix I) confirm severe deterioration across the transformers, reinforcing the need for investment.

5.2.2 Plant 1 Transformer 1 (P1/T1) has been isolated and removed from operational service. In 2020, severe body corrosion caused an oil leak, prompting oil drainage and isolation. Subsequent inspection revealed extensive internal corrosion, rendering the unit beyond repair. Although still physically present, P1/T1 will be removed during the planned replacement works.

5.2.3 In early 2023, BGC/T1 and Plant 2 Transformer 1 (P2/T1) were also isolated due to corrosion. Temporary repairs enabled short-term reinstatement, but these measures do not address underlying structural issues. On Plants 1 and 2, steel base rails of remaining transformers are heavily corroded – one unit currently in service exhibits a visible lean, indicating compromised structural integrity.

Figure 4: Plant 1 T1 Transformer 1 currently isolated

5.2.4 All remaining transformers show advanced corrosion and leakage on tanks and radiator fins. Paintwork is extensively degraded, with rust and flaking clearly visible (see Figure 5 and Figure 6).

5.2.5 Visual inspections also identified deterioration of exposed HV cables due to having been exposed to the environment, with the cable insulation sheath also showing signs of deterioration, further compounding reliability and safety concerns.

5.2.6 For Plants 1 and 2, the Feed Report (Appendix G) raises concerns that the existing transformer bases may be unsuitable for the new [redacted] transformers. NGT is finalising intrusive structural surveys to conform this, with further details provided in Section 7. All remaining transformers exhibit extensive deterioration, with corrosion and leakage visible on tanks and radiator fins.

5.2.7 Visual inspections also identified significant degradation of exposed HV cable insulation and corrosion of cable glands. These findings highlight escalating reliability and safety risks across critical infrastructure.

Figure 5: Corrosion on the radiator fins and connecting cables

Figure 6: Leaking oil from conservator tank and corrosion

6 Options Considered

6.1.1 We considered five options in the June and updated September 2023 submissions, with the preferred Option 5 being to replace the transformers as detailed in Appendix A and approved in the Decision Asset Health Re-opener Applications (January 2023 and June 2023). A recap of these options is provided below. Additionally, the high roof optioneering, which includes a comparative table, should also be noted as part of the overall assessment, even though it is not explicitly discussed in the main narrative.

Table 6: Options Considered

Solution considerations		Option 1 Do Nothing	Option 2 Minor refurbishment	Option 3 Replace/Fix on failure	Option 4 Major refurbishment	Option 5 Replace transformers
Compliance	COMAH	Non-complaint	Non-complaint	Non-complaint	Compliant	Compliant
	T/SP/EL/50	Non-compliant	Non-compliant	Non-compliant	Non-compliant	Compliant
	BS EN 60076-2018	Non-compliant	Non-compliant	Non-compliant	Non-compliant	Compliant
	ECODESIGN	Non-compliant	Non-compliant	Non-compliant	Non-compliant	Compliant
Environmental Impact		Non-compliant with (T/SP/EL/50) on containment systems for bulk oil containing equipment which might lead to contamination	Non-compliant with (T/SP/EL/50) on containment systems for bulk oil containing equipment which might lead to contamination	Non-compliant with (T/SP/EL/50) on containment systems for bulk oil containing equipment which might lead to contaminate	Non-compliant with (T/SP/EL/50) on containment systems for bulk oil containing equipment which might lead to contaminate	Compliant with (T/SP/EL/50) on containment systems for bulk oil containing equipment
Maintenance	Ongoing Maint. need	High - Introduces ongoing inspection and maintenance programme for the high-risk transformers	High - Introduces ongoing inspection and maintenance programme for the high-risk transformers and reactive expensive repairs	High - Introduces ongoing inspection and maintenance programme for the high-risk transformers and reactive expensive repairs	Medium - continuous OPEX challenge to maintain	Low - removes significant effort for ongoing defect management of the transformers
Operational Resilience	Security of Supply	Very high risk of failure. Site currently running on plant back up assets	High risk of failure. Site currently running on plant back up assets	High risk of failure. Site currently running on plant back up assets	Low. As the site has been returned to run as designed with redundancy in each plant	Low. As the site has been returned to run as designed with redundancy in each plant
Cost		No cost. However, the associated risk from failure of the assets and reliance on aged and defected assets for back up is high. This will result in high constraint costs if we are unable to meet our flow obligations.	Option not viable therefore not costed	Option not viable therefore not costed	Option not viable therefore not costed	High upfront cost, current assets are past design life and from a whole life costing perspective replacement delivers the most value for money due to increased reliability of the asset and reduced maintenance costs
Overall viability		Not viable	Not viable	Not viable	Not viable	Viable

6.2 High Store Roof Optioneering

Table 7: High Roof Optioneering

Optioneering Considerations	Option 1	Option 2	Option 3
	Do Nothing	**Targeted Minor Roof Repairs**	**Roof Replacement**
		(Intervention only in areas with potential water ingress. Decommissioning and sealing of current roof vents and openings to create dry enclosure)	(Major refurbishment that includes replacement of roof panels)
Compliance (T/SP/EL/50 - Section 8.8.1.3 states that Dry Transformers shall be designed for installation indoors in clean dry areas)	Non-compliant	Target would be full compliance due to nature of repairs this may not be guaranteed.	Fully Complaint
Durability (Expected lifespan and maintenance required)	Already leaking.	Expected design life of up to 5 years. Anticipate further visits and repairs to continue. Further difficulty in working with live equipment (dry transformers). Any repairs would be an emergency/urgent event.	Minimum 25-year design life linked to the new dry cast transformer units.
Engineering Considerations (e.g. Waterproofing of High Store Area)	Due to extreme weather at St. Fergus very significant temporary works would be needed over the building once transformers are live to create a watertight structure.	Due to extreme weather at St. Fergus very significant temporary works would be needed over the building once transformers are live to create a watertight structure for any repair work.	Due to extreme weather at St. Fergus reduced risk of significant temporary works that would be needed over the building once transformers are live to create a watertight structure.
Cost (Both short- and long-term)	Initially no cost. However, the associated risk from failure of the Transformer and potential inability to meet our flow obligations will result in high constraint costs. High costs from temporary structure on top of the roof once new transformers are installed.	Initial low costs. High costs from temporary structure on top of the roof once new transformers are installed. Costs are ongoing due to limited life of the repairs, requiring repeated interventions.	**Pre Tx installation** Initial medium costs in the short term. Lower costs in the long term. **Post Tx Installation** Initial high costs due to temporary structures needed for waterproofing. Lower costs in the long term.
Safety	Unacceptable and not safe.	Provide acceptable safety environment for installation within the building. More frequent requirements to access the roof for maintenance and/or interventions.	Provide acceptable safety environment for installation within the building. Less requirements to access the roof for maintenance and/or intervention.
Overall viability	Not acceptable option. Currently leaking and so not safe for equipment to be installed.	Costs of creating temporary protection to allow for repairs to be carried out once transformers installed are very significant and would significantly impact Terminal operations.	Preferred full roof replacement in advance of the new transformers being installed (Aug 2026).

6.2.1 Further details including an annotated site map can be found within the previous addendum (Appendix B). In line with the above optioneering and in accordance with the [redacted] report recommendation (Appendix G), the existing MTB mineral oil filled transformers will be replaced with dry cast resin transformers.

6.2.2 This is due to the location and dimension of the existing transformer bays when considering protection against fire according to section 8.7 of BS EN 61936-1:2021. Other applicable reasons for this replacement are available in Section 5 of the [redacted].

6.2.3 Other associated benefit of the new Dry Cast Resin Transformers selected for the MTB Transformers is that there is a reduction in the environmental risk as these transformers do not require bunding (i.e. catch any oil leaks as per the existing transformers) and containment of any oil leakages.

6.2.4 Additionally, the new high store location also provides climate control advantage to the new transformers, with protection from moisture and the saliferous atmosphere at St Fergus. The new dry resin transformers will curtail the risk of fires as they do not have oil content, and any additional risk of fire will be from external sources.

6.2.5 To satisfy this requirement, NGT concluded an optioneering exercise with internal SMEs and determined that replacement of the roof sheeting with a new fire-rated EPDM membrane in the high store is required to ensure that this area is watertight and dry. Additional information can be found in the supporting documentation referenced for this section (Appendix F).

6.2.6 Figure 8 demonstrates that the roof ventilation apertures need to be decommissioned and sealed to ensure full closure and prevent ingress of moisture, air, or contaminants. Additionally, (Figure 7) is an illustration of exterior roof for the high store. NGT have investigated the presence of the damp surrounding the exterior to determine in the optioneering process that replacement of the roof is the preferred option (see Table 7).

6.2.7 T/SP/EL/50 - Section 8.8.1.3 states that Dry cast resin Transformers shall be designed for installation indoors in clean dry areas. The existing equipment store (High Store) adjacent to the existing MTB Substation has been selected as a suitable 'clean dry area' to house the dry transformers.

Figure 7: Roof Ventilation Upward View

Figure 8: Aerial view Roof Ventilation

Figure 9: Roof Damp Area

7 Project Scope, Plan and Cost

7.1.1 As detailed in the 2024 Addendum **(Appendix B)**, the scope is derived from the [redacted] (Appendix G) and approved by NGTs Subject Matter Experts (SMEs). Appendix E is a programme of works NGT and the MWC [redacted]) are undertaking the stages of design and build required for the transformer replacement. For clarity on the base scope of works, see Table 9.

7.1.2 NGT have commenced with the delivery of this project, which will replace the Plant 1 and 2 existing transformers with new fluid filled [redacted] (1250kVA), in existing locations. The MTB transformers will be replaced with dry cast resin transformers (800kVA) in a new location (existing building - High Store).

7.2 Contracting strategy

7.2.1 In line with the delivery of works for the St Fergus HV Transformers replacement project, (NGT) utilised its Electrical Control and Instrumentation (EC&I) Framework for the St Fergus HV Transformers design and Build procurement activity. Specifically, Lot 2 – Telemetry and Electrical (T&E) and Lot 4 – Electrical were applied. Lot 1 – Control Systems Replacement Projects and Lot 3 – Gas Quality and Metering (GQM) were not utilised as they did not align with the scope or contractual requirements.

7.2.2 Procurement engaged suppliers listed under the EC&I framework Lots 2 and 4 [redacted] to invite Expressions of Interest for this contract. The deadline for submission was 21 January 2025. Of the suppliers contacted, only [redacted] submitted an expression of interest.

- Lot 2 – Telemetry and Electrical (T&E)
- Lot 4 – Electrical

7.2.3 A mini competition was conducted under the EC&I Framework for both Lot 2 and 4. However, only [redacted] submitted a response. The remaining suppliers declined to participate, citing insufficient capacity and capability to deliver works at the St Fergus location. Consequently, [redacted] was the sole bidder and was awarded the contract.

7.2.4 Although the award was made directly to [redacted], NGT undertook negotiations on commercial terms, scope, and contractual conditions to ensure alignment on deliverables. This process safeguarded value for money and confirmed that all works would be delivered on time and in accordance with the programme. NEC Option A and Option E were utilised for the direct call-off from the EC&I framework:

Table 8: Contracting Strategy

Framework	Summary
Conceptual Design	NGT entered an NEC Option A contract with [redacted] for the conceptual design stage works.
Detailed Design	Detailed Design works is covered via NEC Option E contract with [redacted]
Build	For the build contract, NGT entered an Option A contract with [redacted] for the delivery of works.

7.3 Cost assurance

7.3.1 Baseline funding for the St Fergus HV Transformer has not been allocated. Spend until June 2025 is reported at [redacted] (2018/19 price base). The spend to date has been quantified within the St Fergus HV Transformer and Distribution Boards Cost Book (Appendix C).

7.3.2 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.

7.3.3 Following the decline from other contractors to tender for the work, NGT appointed [redacted] after it undertook negotiations on commercial terms, scope, and contractual conditions to ensure alignment on deliverables.

7.3.4 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.

7.3.5 The current reported costs within the cost book (Appendix C) for the new required transformer base (Plant 1 and 2) and the high store roof for the MTB transformers are derived from NGT cost estimates utilising estimator-developed quantities and unit rates rather than contractor costs. This is because the approved contractor [redacted] is currently concluding the intrusive and non-intrusive surveys for the Plant 1 and 2 transformer base and are in the process of completing roof repair requirements.

7.3.6 NGT will provide updated contractor costs for these works in a revised cost book submission in March 2026.

7.4 Estimating Uncertainty (EU)

7.4.1 In line with the infrastructure and Projects Authority (IPA) cost estimating framework, the cost estimate has been structured around the fundamental equation: [redacted]. The EU range selected was based on a Class estimate maturity, with a range of +18%/-12% applied. Our Cost and Risk Report (Appendix H) further detail the methodology for calculating the EU on this project.

7.4.2 NGT Cost and Risk Report (Appendix H) outline 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.

7.5 Efficient Cost

7.5.1 The MWC [redacted]) produced detailed FEED study report (Appendix G) and the conceptual FEED report which were conducted as part of the last stage of the conceptual FEED feasibility studies. Outputs from MWC, including cost estimation and delivery programme are included.

7.5.2 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. To assure the [redacted] cost estimates, the activity pricing schedule provided by the MWC has undergone a cost assurance exercise.

7.5.3 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. 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. Through this additional information, durations of activities and detail of allowances were able to be checked against scope activities.

7.5.4 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 EC&I framework, an existing set of contractor rates.

7.5.5 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 (i.e. Bacton and St Fergus terminal asset health projects),
- Lessons learnt from historic delivery projects (i.e. Bacton and St Fergus terminal asset health projects).
- Engagement with various disciplines within across our core departments (Asset, System Operator, Construction and Operations).
- 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.
- Supporting narrative on NGT direct roles and their project responsibilities are contained within (Appendix *C*) Please refer to the NGT Cost tab of the St Fergus Hv transformer cost book for more granular cost detail.

7.6 Programme and Delivery Approach

7.6.1 The revised programme reflects a comprehensive design and procurement phase to address technical complexity and regulatory requirements. Key milestones as per (Appendix *E*)include:

- Contract Award – Detail Design and Build June 2025
- Design and Approvals: Civil and electrical design G35 approvals by mid-2026.
- Procurement: Transformer and protection systems procurement from January 2026 to April 2027
- Construction: Site works commence April 2027, with phased installation across Plant 1, Plant 2, and MTB areas through January 2028.
- Handover: Final commissioning and documentation by February 2028.

7.6.2 This shift from the original 2025 construction window is driven by:

- Impacted lead times for bespoke transformer manufacture, for example, copper winding transformers which NGT require involve longer procurement in comparison to standard aluminium supply.
- Sequencing of works to maintain operational integrity at a COMAH site i.e. aligning to terminal wide outage and operational methodology.

7.6.3 The revised timeline ensures risk mitigation, supply chain certainty, and alignment with NGT's strategic objectives.

7.7 Project scope

Table 9 summarises the scope of works for the replacement of the six transformers. See Appendix *E* for the latest programme of works for transformer replacement.

[redacted] [redacted] scope can be summarised into the following categories below, and further detail can be found in the [redacted] Conceptual FEED report (Appendix G). NGT provided details of the base scope in the St Fergus HV transformers – Additional Funding Request Addendum (Appendix B), progress against elements of the base scope is provided in below.

Table 10: Project Scope

Scope Category	Type of scope	Detail	Scope Change Summary: 2023 EJP (Jun/Sep) - 2024 Addendum (Jun)	Now
Electrical	Base Scope	Decommissioning of old Transformers x6	No change (included in funding request)	No change
		Replacement of existing Transformers x6	Fluid filled [redacted] 7131 HV Transformers type was proposed in June / Sept 2023 submission. At both June / Sept 2023 and June 2024 submissions, the proposal was to install the new transformers in the existing transformer bays. Dry Cast Resin Transformer type HV Transformers was proposed for MTB in new location inside an existing building (High Store) in June 2024 adjacent to the MTB substation compared to the mineral oil proposed in June / Sept 2023 submission. The June / Sept 2023 submission was for installing the new transformers in the existing MTB Transformer Bay.	No change
	Base Scope Support Work	Full Low Voltage (LV) cabling replacement to connect new transformers into existing circuit	Partial LV cable replacement was included in June / Sept 2023 submission. However, full LV cable replacement was proposed for June 2024 submission based on the conceptual FEED recommendation.	No change
		Full/partial High Voltage (HV) cabling replacement to connect new transformers into existing circuit	Partial HV cable replacement was included for Plant 1, 2 and MTB in June / Sept 2023 submission. For June 2024 submission, partial HV cable replacement was recommended for Plant 1 and 2, while full replacement was recommended for MTB transformers due to the new location (High Store) for the new HV transformers.	No Change

	Base Scope – Support Work (limited life)	Installation of Neutral Overcurrent Protection Panels, Battery Tripping Panels, Transformers Protection Panels	This scope was not envisaged during June/Sept 2023 submission as there was no conceptual FEED to support the submission. Hence not accounted for during June / Sept 2023 submission.	No change
Civils	Base Scope Support Work	MTB: new support steelwork structure to house the Cast Resin transformer. Roof replacement for the dry transformers to be in the high store. Intrusive surveys	Installation of the MTB transformer in the new location is the recommendation from the conceptual FEED and was not considered during June / Sept 2023 submission. June / Sept 2023 EJP submission proposed to install the new MTB transformers in the existing location.	No change
		Plant 1 and 2: Asbestos floor tile removal modification to the existing Transformer Bay, compliant	This scope was not accounted for in June / Sept 2023 EJP submission.	No change
Control & Instrumentation	Base Scope – Support Work	Install sump level detection and alarms	June / Sept 2023 EJP submission scope included the use of marshalling panels as a termination point, including capacity for future proofing and additional redundancy for existing or new network interfacing systems. However, conceptual FEED study did recommend only installing the sump level detection and cabling the signal back to the Plant Panel PCB1 and PCB2 control room for alarm.	No change

7.7.2 Table 11 sets out the key deliverables and their acceptance requirements for the St Fergus HV Auxiliary Transformer replacement.

Table : Summary of Key Project Deliverables

Deliverable	Description
Safe, fit-for-purpose transformers	Provide secure by design, reliable, and maintainable HV Auxiliary Transformers and associated equipment, suitable for present and future operations, while sustaining operational capability of the St Fergus Terminal (ref T/SP/EL/50 and T/SP/COMP/30).
Minimum 25-year design life	Replacement Auxiliary Transformer and associated equipment should have a minimum 25-year design life (ref T/SP/EL/50 – section 1.4) with OEM lifecycle support and spares availability. Supplier/OEM to provide obsolescence management plan.
Civil and drainage compliance	Upgrade/redesign civil and drainage assets to comply with NGT electrical specifications (ref T/SP/EL/50 – section 8.7.4) for containment systems for bulk oil equipment – specifically for Plant 1 and 2.
Phased implementation	Implement replacement assets in a phased approach to allow flexibility for operational constraints, outage dates, and commissioning fallbacks to avoid significant impact on operations and gas flow.
Integration and future-proofing	Integrate with retained systems and provide capacity for future modifications. Consider marshalling panels for termination points, redundancy, and futureproofing (ref T/SP/EL/50 and T/SP/COMP/30).
Regulatory compliance	Meet COMAH Competent Authority (HSE) expectations and Critical National Infrastructure security requirements.

7.8 High Store Roof Replacement- Proposed Scope of Works

7.8.1 As outlined previously in the June 2024 St Fergus High Voltage Transformers - Additional Funding Request Addendum (Appendix B), the MTB transformers will be replaced with dry cast resin transformers in a new location within the existing high store building

7.8.2 This work is being carried out [redacted] and is not part of the scope for the Transformer replacement being undertaken [redacted]

7.8.3 As determined in the high store roof optioneering above (Table 7), and following further review and discussions with consulting engineers, the preferred solution is a modern replacement of the existing roof coverings. The proposed scheme includes:

- Stripping the roof back to the concrete deck, removing ventilation cowls, penetrations, and other redundant items.
- Installing a new fire-rated EPDM membrane on an improved insulated substrate laid to falls, with all associated requirements.
- Increasing the parapet height by one or two courses of concrete blockwork for better edge protection and water shedding.
- Sealing penetrations within timber frames aligned to deck levels.
- Applying a vapour control layer lapped up parapet walls.

- Installing Rockwool Hardrock tapered insulation (non-combustible, min. 1:40 fall) with additional 25mm insulation up parapet walls.
- Fitting Firestone Rubbercover EPDM roof membrane over insulation and lapped up parapet walls.
- Adding polyester-powder-coated steel coping around the parapet to cover existing cladding panels.
- Decommission and sealed roof ventilation apertures to ensure full enclosure and prevent ingress of moisture, air, or contaminants.

7.9 Transformer Bay – Proposed Scope of Works

7.9.1 The FEED report (Appendix G) identified several options for evaluation to determine whether the existing Plant 1 and Plant 2 bays can adequately accommodate the new Midel transformers. The below table provides an assessment on the suitability of the existing bays for the new plant 1 and 2 transformers.

Table 11: Proposed Scope

Scope elements	Scope details	Progress
Scope 1	Assessment of transformers bay existing pilling and working load capacity	Testing is ongoing to ascertain condition and structural capacity of the existing foundations to enable an informed decision to reuse the existing foundations. This information will also be required to feed into Option 2.
Scope 2	Investigate options to strengthen the existing structures in situ.	Optioneering and subsequent detailed design report are being produced to support and supplement the transformer structures, replacement blast walls and roof structure design.
Scope 3	Install new transformer bay/pilling.	Further, proposed solutions such as modular builds are being explored to limit timescales and mitigate operational constraints.

7.10 Project Costs

[redacted]

[redacted]

7.10.1 NGT is conscious that Ofgem generally applies a 10% risk cap; however, the wide ranging and extensive scope of asset health at St Fergus comes with high complexity, and more scope means more uncertainty. Through extensive risk reviews with internal and external specialist stakeholders, factoring in unique project complexity and uncertainties, detailed quantified risk registers were developed subject to Monte Carlo analysis resulting in a higher-than Ofgem's risk cap. St Fergus due to its coastal location is also subject to higher risk of delivery delays due to adverse weather compared with similar asset health projects at other NGT locations.

7.11 Volume InvIDs (Investment Identification)

7.11.1 Costs associated with this project have been assigned against the **InvID C-344 - ST FERGUS TERMINAL – Transformer Replacement.**

7.11.2 Table 11 below provides a summary of the InvIDs and associated funding for the scope of works proposed in this paper.

[redacted]

7.11.3 The cost accuracy at this stage of the project is estimated [redacted] in accordance with the IPA cost estimating guidance.

7.11.4 This EJP has explained the safety concerns NGT has regarding the defective transformers and the implications of these on terminal operations. The intervention is necessary to ensure the safety of terminal personnel and ongoing 24/7/365 operation of the terminal facility.

8 Conclusion

8.1.1 This report has explained the asset health and compliance shortcomings of the HV transformers at St Fergus and their implications to the safe and reliable operation of the terminal.

8.1.2 As detailed in this justification paper, it is of paramount importance to secure the necessary investment to address the highlighted investment drivers.

8.1.3 Removal and the subsequent replacement of transformers and their associated works at the St Fergus gas terminal [redacted] (CEPOt 2018/19 Prices). NGT will provide an updated funding request in March following contractor completion of transformer bays and high roof store replacement costs.

9 Appendices

Appendix A: NGT_AH2_03_HV Transformers EJP_Updated

Appendix B: NGT_St Fergus HV Transformers Addendum_June 2024.pdf

Appendix C: St Fergus HV Transformer and Distribution Boards Cost Book

Appendix D: HV Transformer Risk Score

Appendix E: Programme of Works

Appendix F: 25060 NG High Store Roof Prelim Inspection Report Rev A

[redacted]

Appendix H: NGT Cost and Risk Report - DB and Hv Tx

[redacted]

10 Glossary

Glossary	
CBA	**Cost Benefit Analysis:** A mathematical decision support tool to quantify the relative benefits of each site option.
CDS	Conceptual Design Study
COMAH	Control of Major Accident Hazards (COMAH) Regulations 2015. Bacton Terminal is one of two designated NGT COMAH establishments. The other being St Fergus Terminal
DSEAR	Dangerous Substances and Explosive Atmospheres Regulations 2002
ECI	Early Contractor Involvement
EJP	Engineering Justification Paper
Entry Capacity	Holdings give NTS users the right to bring gas onto the NTS on any day of the gas year. Capacity rights can be procured in the long term or through shorter term processes, up to the gas day itself. Each NTS Entry point has an allocated Baseline which represents a level of Capacity that NGT is obligated to make available for delivery against on every day of the year
EPC	Engineering Procurement and Construction
Exit Capacity	Holdings give NTS users the right to take gas off the NTS on any day of the gas year. Capacity rights can be procured in the long term or through shorter term processes, up to the gas day itself. Each NTS Exit point has an allocated Baseline which represents a level of Capacity that NGT is obligated to make available for offtake on every day of the year.
FEASIBILITY	**Front End Engineering Design:** The FEASIBILITY is basic engineering which comes before the Detailed Engineering stage. The FEASIBILITY design process focusses on the technical requirements as well as an approximate budget investment cost for the project.
FES	**Future Energy Scenarios:** An annual industry-wide consultation process encompassing questionnaires, workshops, meetings and seminars to seek Feasibility back 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.
FOS	Future Operating Strategy
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

Glossary	
MWC	Main Works Contractor
(G)NDP	**Network Development Process:** The process by which NGT identifies and implements physical investment on the NTS.
NEA	Network Entry Agreement
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.
OEM	**Original Equipment Manufacturer**
Ofgem	**Office of Gas and Electricity Markets:** The regulatory agency responsible for regulating Great Britain's gas and electricity markets.
PFD	**Process Flow Diagram**
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