national gas transmission

NGT_AH2_02 St Fergus Site Strategy

June 2023

Issue: 2.1

Version: Final

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1. Introduction

1. The St Fergus Gas Terminal, which receives gas from three sub-terminals, is currently one of the highest utilised sites on the National Transmission System (NTS). It is a site of fundamental importance to the UK as it provides security of supply and access to gas from the UK Continental Shelf (UKCS) and Norway. Both sources help to minimise gas prices. Additionally, the uninhibited transportation routes for UKCS gas at St Fergus enables offshore oil production which also benefits the UK economy.
2. The terminal has been in continuous operation for over 40 years and requires a level of investment to both re-life assets on the terminal and make compressors, that receive gas from the North Sea Midstream Partners (NSMP) sub-terminal, compliant with environmental legislation.

Document Purpose

3. This document is part of a suite of documents shown in Figure 1. It describes the terminal's function, its criticality to the network and the proposed investments. These investments support the site's short and long-term strategies. It is advised that this document should be read in conjunction with all the Engineering Justification Papers that are included within the Asset Health Uncertainty Mechanism (UM) Submission.

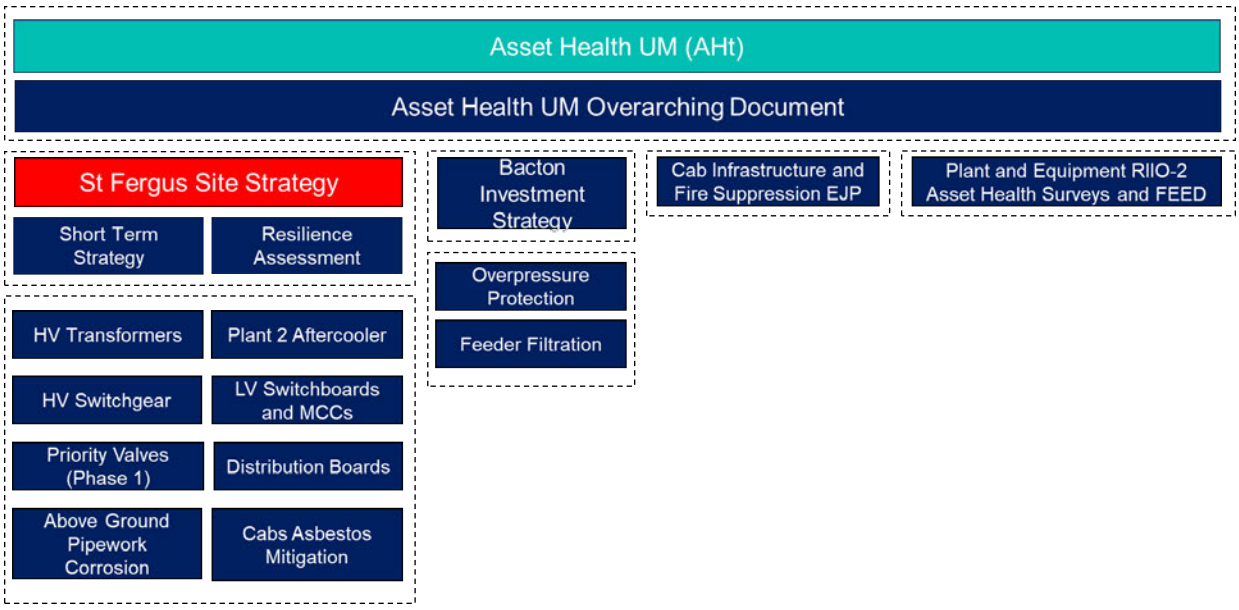

Figure 1: St Fergus Submission Documents Structure

4. The primary purpose of this version of the St Fergus Site Strategy is to support the submission of the above eight Asset Health investments. It will also draw links between these and other planned investments.

5. This document has been updated since v1.1 was submitted in January 2023. The key changes are:

- Inclusion of an update on Ofgem's response to our Emissions Compliance investment proposal.
- Inclusion of the eight Asset Health investments which were prioritised from a longlist of around twenty for inclusion in this Asset Health Re-opener submission. These are split between being aligned with our short and long-term strategies.
- Addition of a section on the electrical systems of the site to provide a useful overview for the accompanying electrical EJPs.
- Addition of a section on the pipework and valves of the site to provide a useful overview for the accompanying Above Ground Pipework Corrosion EJP.
- Addition of a challenges section to highlight the general challenges being contended with in developing these investments.

Our Strategies

6. In developing our investment programmes at the St Fergus Gas Terminal since the RIIO-T2 Final Determination, we have adopted a two-phase strategy to ensure clarity between short-term asset health and long-term site operating strategy.
7. Our St Fergus Short-Term Strategy, included in Appendix 1, provides certainty on the terminal operation requirements, including minimum compression across Plant 1 and Plant 2, for operation up to 2030. The long-term strategy will deliver the enduring terminal solution, including compression, required for operation beyond 2030. However, work will begin on investments that align to both short and long-term strategies in the RIIO-T2 period.

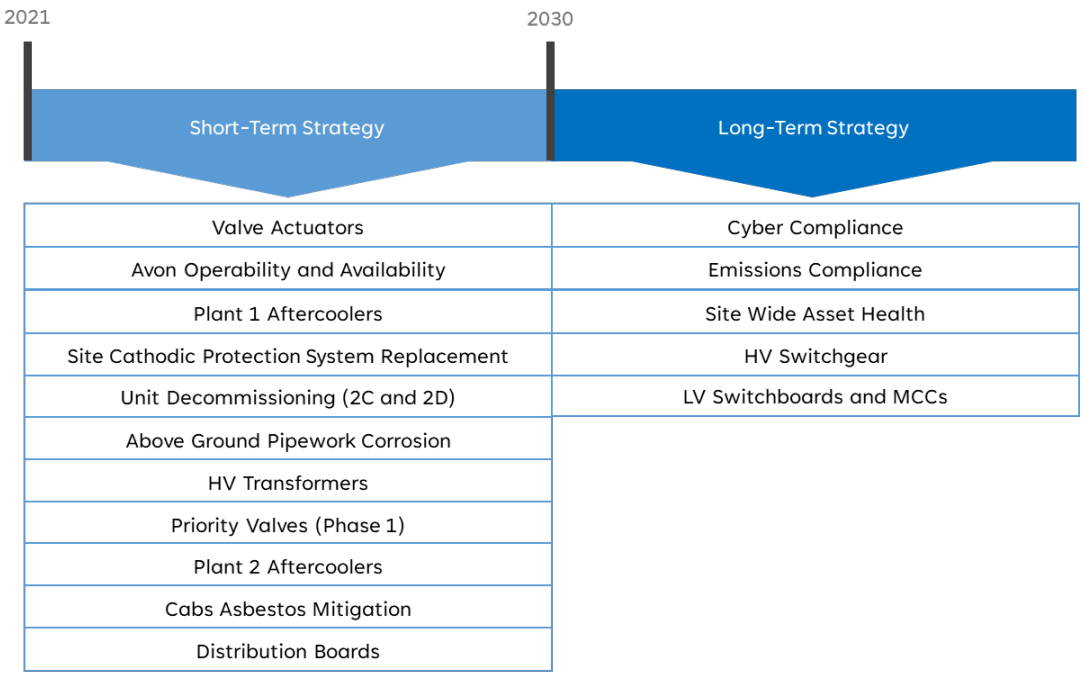

Figure 2 - St Fergus Strategies Summary

8. The St Fergus Short-Term Strategy sets out the approach to rationalise the compression units across Plant 1 and 2 to four Avon units (1A, 1B, 1D and 2B) and maintain these in operation to at least 2030. In addition, it supports the decision to cease investment, disconnect and subsequently decommission redundant units. This unit rationalisation would significantly reduce the cost to consumers whilst maintaining plant availability and reliability.

9. In support of these goals, five Engineering Justification Papers were submitted through the Asset Health Reopener in January 2023. A further eight are now being submitted through the Asset Health Reopener in June 2023 with the potential for more to follow in January 2024 or through our RIIO-T3 business plan submission.

10. The Long-Term Strategy is centred around compliance with emissions legislation but also encapsulates a wider view of asset requirements at the terminal. It thus informs the short-term Asset Health decisions since the need for short-term investment may be dependent upon the future of the asset involved.

11. In support of both these strategies, we have also assessed the potential for rationalisation across the site to optimise our proposed capex and long-term Opex. The result of this analysis is included in Appendix 2 – Resilience Assessment.

Our Investment Recommendations

12. Through the St Fergus Emissions Uncertainty Mechanism submission, we proposed our preferred option for compliance with emissions legislation. Our preferred option is four unrestricted units (three new units and one Dry Low Emissions (DLE) retrofit trial unit). This option represents the optimum solution for achieving emissions compliance, ensuring the long-term Security of Supply of the UK and delivering value for consumers. For more detail on this investment see the St Fergus Final Option Selection Report (FOSR) which was submitted in January 2023. On 2 June 2023, Ofgem launched a consultation[1] on their proposal to accept our Final Preferred Option.

13. As part of the Feasibility process, we have determined that there is not a site wide subsidence issue that will affect future operation. There is evidence of localised occurrences of subsidence, therefore we plan to request upfront funding for detailed survey and optioneering through the next Asset Health UM Submission window of January 2024. This will then provide the basis for a baseline funding request in our RIIO-T3 submission.

14. Through the Asset Health January 2023 UM, we proposed various investments which will ensure the continued, safe operation of the site until 2030. As a result of engagement with Ofgem through FY21, it was agreed that National Gas Transmission (NGT) will utilise the Asset Health Reopener Submissions to request funding for these and further Asset Health investments. These were included as part of our rationalisation assessment and, where appropriate, as part of our Emissions FOSR Cost Benefit Analysis (CBA) costs. However, the scopes and costs for some investments were still in development at the time.

15. We communicated with Ofgem that our proposed solutions for some asset health works had commenced, resulting in a submission that represented a request for funding of costs incurred to-date and then requesting allowances for the remainder of the works. Those investments covered Valve Actuators, Plant 1 Aftercoolers, Cathodic Protection System, Unit Decommissioning (2C and 2D) and work to restore a fourth Avon unit to operation. For more detail on these investments, see each corresponding Engineering Justification Paper (EJP) submitted in January 2023.

16. These are now to be supplemented by additional investments covering Plant 2 Aftercoolers, Valves, Above Ground Pipework Corrosion, Asbestos and a variety of electrical assets as shown in Table 1.

[1] https://www.ofgem.gov.uk/publications/st-fergus-compressor-emissions-final-preferred-option

Product Name	Investment commenced at risk?	Total Cost (£m)	Funding Request (£m)
St Fergus Actuators EJP	Y	[redacted]	
St Fergus Plant 1 Aftercooler EJP	Y		
St Fergus Avon Operability EJP	Y		
St Fergus Unit Decommissioning EJP	N		
St Fergus Cathodic Protection EJP	Y		
St Fergus Asset Health January 2023 Total	***N/A***		
St Fergus Cabs Asbestos Mitigation	***N***		
St Fergus HV Transformers	N		
St Fergus Above Ground Pipework Corrosion	Y		
St Fergus HV Switchgear	N		
St Fergus Priority Valves (Phase 1)	N		
St Fergus Plant 2 Aftercooler	N		
St Fergus LV Switchgear and MCCs	N		
St Fergus Distribution Boards	N		
St Fergus Asset Health June 2023 Total			
St Fergus Emissions FOSR	N		
St Fergus Emissions Total	***N/A***		
ST FERGUS TOTAL	**N/A**	[redacted]	**129.794**

Table 1 – St Fergus Investment Summary January and June 2023 Submissions

17. These additional eight investments were prioritised from a longer list of around twenty scopes which have been assessed by our contractor. These eight were deemed to be the most important to begin within RIIO-T2 whilst being less urgent than those which were submitted in January 2023 after having proceeded in advance of the submission.

Investment Timing

18. The eight proposed Asset Health investments, although operationally critical, were deemed to be less urgent than those submitted in January 2023. Therefore, we could afford to spend more time in developing the correct options and justification.

19. They also involve assets across Plants 1 and 2 and were therefore affected by decisions on the future for those areas of the site. Waiting until the future of those plants was clear, allowed us to ensure the proposed Asset Health investments contain the correct quantity and design of assets in order to ensure efficient spend for consumers.

[2] This represents an indicative total project value at this stage.

20. The remainder of the scopes which have been developed and further issues which are identified will be assessed and prioritised either for submission in January 2024 where the work needs to commence within RIIO-T2 or through the RIIO-T3 business plan.

AH Submission	January 2023	June 2023	January 2024/ RIIO-T3
Driver for inclusion at that time	Urgent safety or operability critical investments. These had commenced in advance of the submission or would need to start prior to funding approval.	Operationally critical investments where it was deemed timely to develop the funding request and submit prior to starting the works and continue managing the risk in the short term.	Items that have additional complexity and interact across multiple EJPs thus allowing time for the scopes to be congruently developed. Where not safety, reliability or obsolescence critical, investment will be deferred into RIIO T3'
EJPs included	Valve Actuators	HV Switchgear	Subsidence
	Plant 1 Aftercooler	HV Transformers	Fuel Gas Heating
	Avon Operability and Availability	LV Switchboards and MCCs	Standby Generators
	Cathodic Protection	Distribution Boards	Fire Water Ring Main
	Unit Decommissioning (2C and 2D)	Above Ground Pipework Corrosion	Damaged and Broken Drainage Asset Replacement
		Plant 2 Aftercooler	Site Ducting
		Cab Asbestos Mitigation	VSD Access Roof Panel
		Priority Valves Phase 1	Access Road Monitoring & Replacement
			Vent System
			Lube Oil System
			Lighting
			Tanks and Bunds
			Significant Structures
			Fire Suppression

Table 2 – Rationale for Investment Inclusion in Different Submissions

Who Pays

21. In line with the requirements set out in the RIIO-T2 Final Determination document, the question of who should pay for compressor capital costs at St Fergus has been taken forward and will be explored further at the NTS Charging Methodology

Forums. The proposed investments are required regardless of the outcome of these discussions.

2. The Importance of St Fergus to the NTS

22. The St Fergus Gas Terminal is located on the North-East coast of Scotland. The terminal connects to three sub terminals currently owned by Shell, Ancala and North Sea Midstream Partners (NSMP). The Terminal brings gas from the North Sea and Norwegian gas fields into the UK Gas NTS.

Figure 3 – St Fergus Terminal Location

23. The site operates 24/7/365, regularly supplying 25% to 50% of the UK's natural gas supplies and currently expected to continue to supply significant quantities of gas for decades to come based upon the Future Energy Scenarios and feedback from stakeholders.

24. NGT provide compression for gas received from the NSMP terminal under the terms of the Network Entry Agreement (NEA), a legacy arrangement dating from when British Gas was privatised.

25. The terminal has been in continuous operation for over 40 years and requires a level of investment to both re-life a number of assets on the terminal and to make the compressors that receive gas from the NSMP sub-terminal compliant with new environmental legislation.

3. St Fergus Site Overview

26. Supplies to the terminal from the Shell and Ancala sub terminals are metered then mixed and enter the NTS directly at the prevailing pressures required. Supplies from the NSMP sub terminal arrive at the terminal at 40barg and are scrubbed, metered then compressed to raise the pressure. Depending on network conditions this is typically to between 60-65 barg. The gas is then cooled by the aftercoolers to remove the heat of compression before being mixed with Shell and Ancala gas and then entering the NTS. The gas is supplied into the NTS down the five pipelines towards Aberdeen and further south. A high-level overview of the site layout is provided in Figure 4 below.

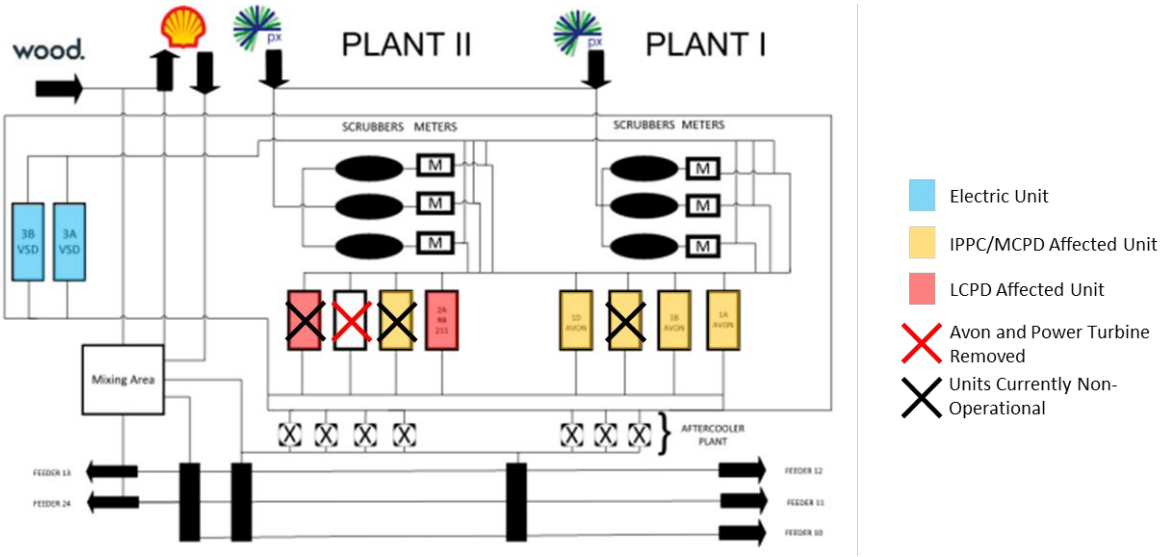

Figure 4 – St Fergus Terminal Site Layout

27. The compression on site is provided by either one of the gas compression units (Avons and one operational RB211) or the electrical Variable Speed Drive (VSD) units. The terminal operates 24/7/365 and is not afforded regular outages from sub-terminals to undertake maintenance.

28. Sections of Plant 1 and Plant 2 serve as redundancy for each other allowing NGT to undertake statutory inspections and critical testing of our safety critical and emergency shutdown systems in addition to any maintenance needed as a result of regular inspections and testing. The scrubbers, metering, suction/discharge manifolds and Aftercoolers are duplicated across Plants 1 and 2 to enable maintenance and therefore can be viewed independently from the need for compression across the two plants. These areas of the site are highlighted in Figure 5.

Figure 5 – Aerial Photograph of the St Fergus Terminal Highlighting Different Plant Areas

29. We have reviewed the assets across Plants 1 and 2 to identify any opportunities to rationalise and reduce short-term capex or long-term opex. The result of this analysis is provided in Appendix 2 – Resilience Assessment.

4. Key Asset Groups on Site

Compression Assets

30. This section outlines the compression assets currently on the site, how they are used and what resilience is built into the design. It does not reflect our proposals for new compression in the future, which is covered in the Long-Term Strategy section.

Site Timeline

31. As the site has been in operation for over 40 years, there have been significant changes in the compression operational on site over that time. Highlighted in Figure 6 are the key events in the history of site compression and upcoming fixed deadlines.

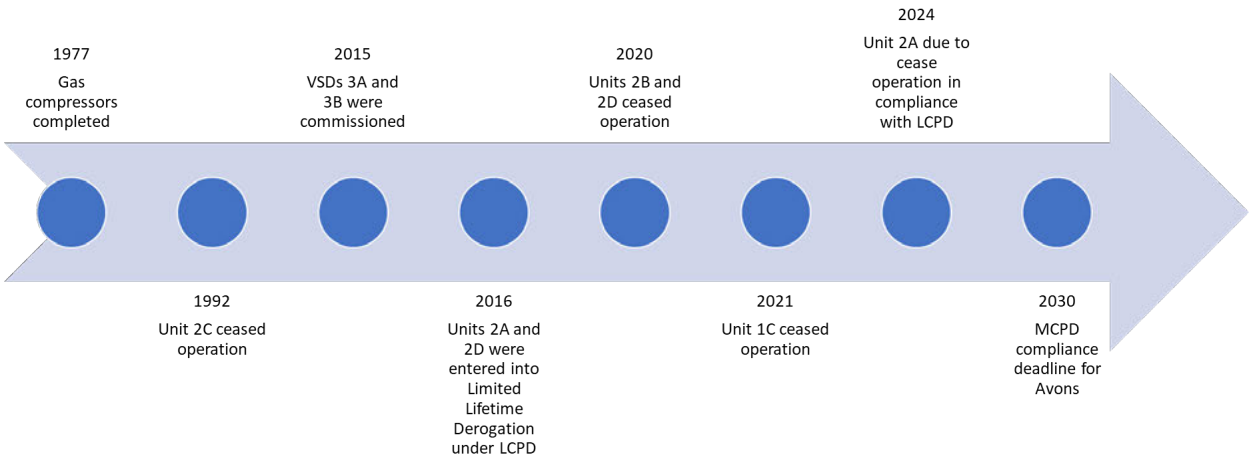

Figure 6 – Timeline of Key Compression Events at St Fergus

Gas Driven Compressors

32. For around 35 years of operation (circa 1977 to 2012) two RB211 driven compressor units provided primary compression capacity at the St Fergus site, run in conjunction with the five Avon compressor units; the sixth Avon Unit 2C was mothballed in 1992. This configuration provided successful operation for many years. A significant change occurred when the Plant 3 electrically powered VSD units were introduced, and since then the VSDs and Avons have provided the main compressor capacity, with the RB211 units being used as backup to the VSDs.

33. As highlighted in Figure 6, Units 2A and 2D are RB211s impacted by the Large Combustion Plant Directive (LCPD). Units 1A, 1B, 1C, 1D and 2B are all Avons, impacted by the Medium Combustion Plant Directive (MCPD). See our Compressor

Emissions Asset Management Plan (CE-AMP) submitted in January 2023 for more information on the emissions legislation 3.

34. Of these, Units 1A, 1B, 1D and 2A are currently operational. Unit 2A was entered into a Limited Lifetime Derogation (LLD) under the LCPD which means that it is due to cease operation from 31 December 2023.

35. Unit 2B ceased operation in 2020. Investments are currently in progress to bring the unit back into service by March 2024.

36. Unit 2C has been an 'empty' cab since 1992, with only the gas compressor left inside which has not been maintained. Since the unit was removed from operational service there are no records of exhaust or structural inspections being carried out on the cab. Unit 2C is beyond the point of return to operational service.

37. Unit 2D was also removed from operational service in 2020 due to concerns about the integrity of the exhaust stack. The units have been removed from operational service and isolated from fuel gas supplies. Oil has been removed from the buildings so the risk of fire and explosion is reduced. Unit 2D is an RB211 unit which cannot be used for operational service beyond 2023.

38. Unit 1C ceased operation in 2021. An inspection carried out by the Original Equipment Manufacturer (OEM) uncovered cab structural integrity issues which did not support the continued operation of the unit. In addition to the cab issues, the main line discharge valve was passing badly; after this was identified the unit was depressurised and isolated. In order to return to an operational state it would also require work on the ventilation and power turbine.

Electrically Driven Compressors

39. Both the Variable Speed Drive (VSD) compressors were commissioned in 2015. Units 3A and 3B are both currently operational.

40. These units are dependent upon the ancillaries provided by Plants 1 and 2 (e.g. scrubbers, suction and discharge manifolds and aftercoolers). They are also reliant upon the power supply, unlike the Gas Turbines (GTs) which can be run using standby generation.

Compressor Capability

41. The VSDs are the primary units as they are the Best Available Techniques (BAT) units on site. They provide duty for 20-30 mcmd flow and two VSDs in parallel support 40-60 mcmd.

42. The Avons have two roles: supporting flow ranges which cannot be achieved by the VSDs and providing back-up to the VSDs. At least one Avon is required to provide

[3] https://www.nationalgas.com/about-us/business-planning-riio/our-riio-2-business-plan-2021-2026/our-riio2-reopener-applications-2021-2026

duty for 9-15 mcmd flows and two Avons in parallel also provide duty for 15-17 mcmd flow range. At least four Avon units are required to operate in parallel to provide nominal backup to both VSDs.

43. These roles are summarised in Figure 7. For each of these flow ranges, at least one Avon would also be necessary as backup as these are very old units. The compressor availability used in our assessments has been based on the Reliability Availability Maintainability (RAM) model developed in collaboration with [redacted] An overview of the RAM model and how it has been applied and used in the Emissions CBA can be found in CE-AMP.

44. The maximum end of day dominated flow is 72 mcmd, though in recent years the highest that has been seen is 60 mcmd.

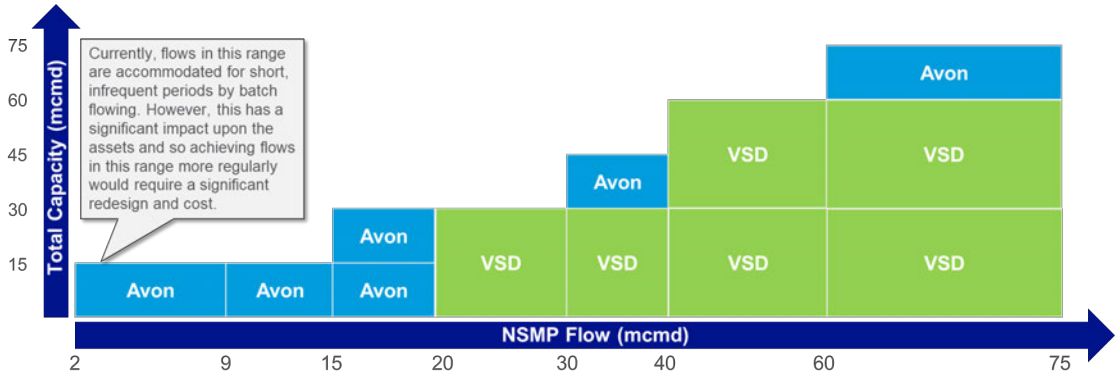

Figure 7 – St Fergus Unit Capability

45. This image does not include the RB211 (Unit 2A) as this is on a Limited Life Derogation and is due to cease operation from 31 December 2023; in the CBA it is modelled as having the same range as the VSDs.

Changing Capability Over Time

46. The original design of the site included a fairly balanced split of gas compression with a total of eight units between Plants 1 and 2. The ceasing of operation of various units has resulted in the majority of gas driven compression being located on Plant 1.

47. If nothing is done then, following the LCPD deadline, gas compression will only be present on Plant 1 with a total of five units overall. This results in insufficient resilience and multiple single points of failure for the gas compression which is unacceptable. As a result, our Short-Term Strategy proposed investment (captured in the Avon Operability and Availability EJP) to return Unit 2B to operation. The selection of Unit 2B rather than Unit 1C is further supported by our Resilience Assessment which highlights the benefits of continuing to operate compression over both Plants 1 and 2.

48. The change in capability of the site over time, as a result of the changes described previously and changing supply patterns, is shown in Figure 8.

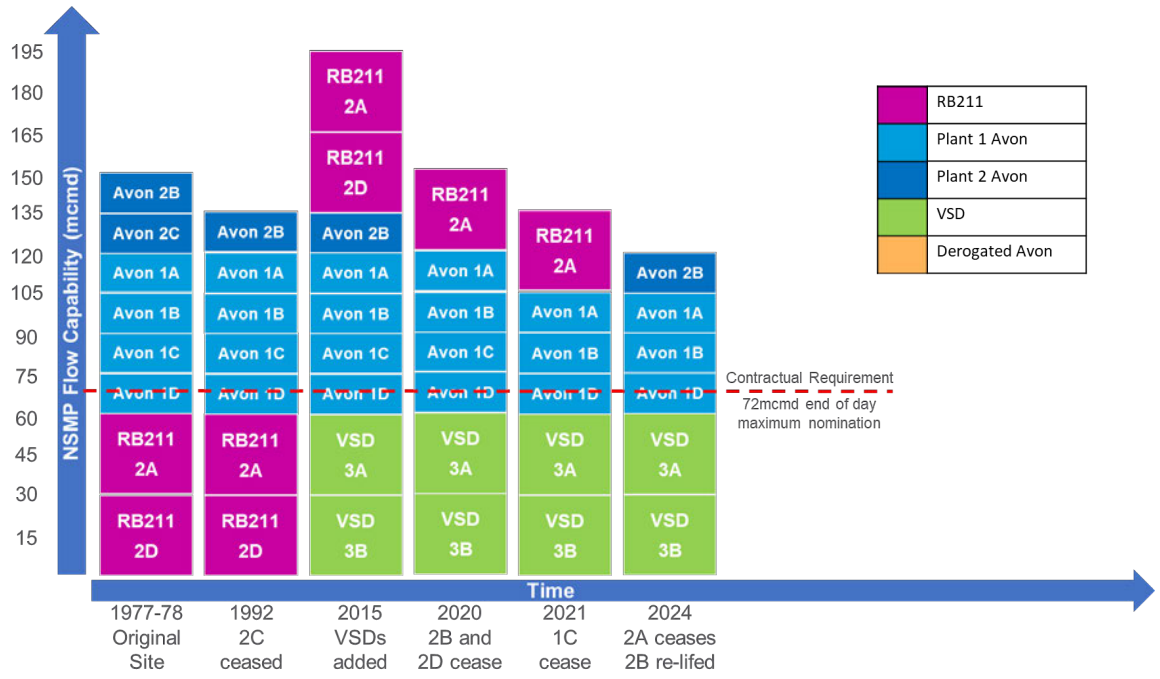

Figure 8 – Site Capability Changes up to 2030

49. The image above assumes that all operational units on site are available. However, individual units would require planned maintenance and there are known issues that would require an entire Plant 1 outage to resolve which would make all the remaining Avons unavailable simultaneously. Without the return of Unit 2B, this would result in a capability below our contractual requirement.

Compression Resilience

50. Resilience is incorporated into the Terminal's design strategy and as such, the existence of Plants 1 and 2 is not to support a specific compression plant, but rather to support any compression being undertaken.

51. The resilience is necessary to ensure that gas received from the NSMP Sub-Terminal can enter the NTS. NSMP undertake brief outages (less than 12 hours) twice a year for completion of Proof Testing Procedure (PTP) functional safety compliance checks on the National Grid Terminal. NSMP have not had a complete plant outage longer than 12 hours since 2012.

52. As NSMP have resilience built into their plant to accommodate their 24/7 operation, St Fergus gas Terminal is required to be equally resilient to maintain safe and successful operation ensuring continuous flow of gas as required by NSMP. Any loss of compression would result in upstream shipper disruption in both gas and oil production, and subsequent cost and environmental impacts.

53. Resilience on the site is mainly achieved through redundancy which facilitates planned and unplanned maintenance of assets without impacting compression on site. This is particularly important as some of the assets are well beyond their

design life and will require major interventions, requiring a compression outage if there was no redundancy, within the next 10 years.

54. To ensure we are delivering the best value for our customers, in January 2023 we reviewed the site to identify any opportunities for rationalisation to optimise our proposed capex and reduce long-term opex costs whilst maintaining a stable level of risk that ensures the site is able to meet its compression requirements.

55. As part of this analysis, we were able to save £5.4m (a 4.6% reduction) of the initial proposed asset health costs by optimising the scopes. We also considered the impact upon short-term asset health proposals under multiple site configurations.

56. Overall, we confirmed that maintaining two plants is the most feasible option (from a project delivery and operational perspective) which is also in line with our future operating strategy.

57. This work has been captured in Appendix 2 – Resilience Assessment and the table below highlights the key results.

Investment	Configuration 1 GTs split between Plants 1 and 2	Configuration 2 All GTs on Plant 1	Configuration 3 All GTs on Plant 2	Configuration 4 GTs on new location
Risk	Low risk	High risk	High risk	Medium risk
Deliverability	High	Low	Medium	Medium
Estimated Total Savings till 2050	N/A	£833,606k	£903,333k	-£54,9475k
Summary statement	- Maintains resilience - Complies with spacing requirement - Up to 4 Avons to support construction	- Does not comply with spacing requirements - Cannot return 1C to operation in time needed - Maximum 1 Avon available during construction	- Does not comply with spacing requirements - Lower resilience long term	- Significant capex requirement - Cannot include DLE retrofit in long-term solution

Table 3 – Summary of compression configurations analysed

Electrical Systems

Electrical Assets

58. The June Asset Health submission includes multiple investments related to the electrical systems at St Fergus. The majority of these were installed during the site's original construction over 45 years ago and as a result they are seeing an increase in defects, it is more challenging to source spare parts and they don't comply with updated safety guidance.

59. As these systems are interconnected, Figure 9 provides a high-level view of how these systems connect.

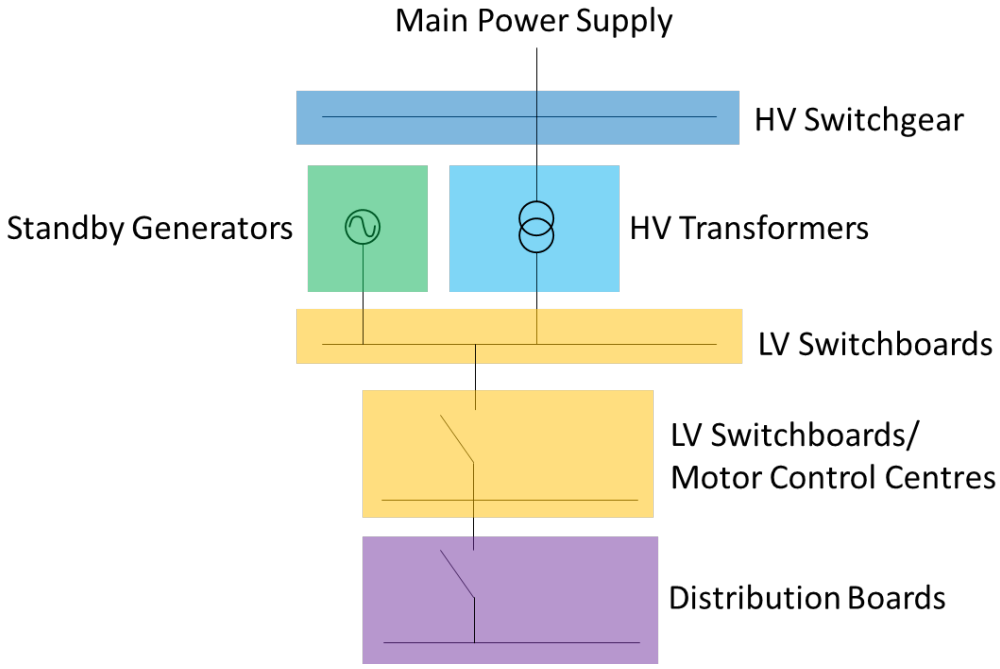

Figure 9 - High Level Electrical System Diagram

60. The main power supplies for the National Gas St Fergus Gas Terminal originate from the Scottish and Southern Electricity Network (SSEN) Substation located within the NGT's terminal perimeter fence line. This then interfaces with NGT's High Voltage (HV) switchgear which consists of 15 panels containing Oil Circuit Breakers (OCBs) and Vacuum Circuit Breakers (VCBs).

61. The outgoing power is then directed through HV Transformers to the Low Voltage (LV) switchboards and Motor Control Centres (MCCs). The HV transformers step down the electrical supply from the SSEN Substation. This takes 11kV down to a 3-phase 415V supply suitable for the Terminal.

62. There are eight HV transformers in total. Six of these are legacy transformers which serve three site areas: the Main Terminal Building (MTB), Plant 1 and Plant 2. Each of these areas are fed by two HV Transformers each for security of supply; with one transformer as the lead and the second as back-up. Additionally, it is possible for Plant 1 to be fed by the Plant 2 transformers and vice versa. However, these plants

are designed to operate separately with the electrical interconnector closed only for specific works. There is additional risk of a trip of the entire compression plant if both plants are operating on a single transformer. The Plant 3 VSD compressors are each served by one HV transformer, with no back-up.

63. Three standby generators provide back-up to the mains electrical supply for the MTB and Plants 1 and 2.

64. LV switchboards are used for the connection of incoming Distribution Network Operator (DNO) supplies and providing distribution to downstream LV loads, distribution boards and MCCs. Low Voltage MCCs are used for downstream distribution to LV loads which are principally electric motors.

65. In total, there are 19 LV switchboards and MCCs covering the NGT Main Terminal Building (MTB) area, Plant 1 Substation, Plant 2 Substation and Plant 3 Substation (VSD supply).

66. Finally, Distribution Boards are connected to the LV switchboards and split the incoming electrical power feed into multiple secondary or subsidiary circuits.

Asset Condition

67. Figure 10 is a site electrical drawing which highlights the majority of electrical assets which have been surveyed, however it does not include the distribution boards or Plant 3.

Figure 10 - St Fergus Site Electrical Drawing

68. The HV switchgear does not include technical features required for safe operation, has no OEM support and faces obsolescence issues.

69. Three of the six legacy transformers (one on each of the three areas) have had to be electrically isolated as they suffered from oil leakage caused by severe corrosion of the tanks. This has left each area currently running on its back up option. This leaves the MTB reliant on the use of a standby generator for back up should its remaining transformer fail. Plant 1 and 2 have slightly more resilience as they can be electrically interconnected to share transformers, however operating in this configuration decreases resilience.
70. The standby generators are not included in the June Asset Health submission as more work is needed to develop options to address obsolescence of control systems and the ability to source spares. This investment will be included in a later submission as they act as a line of last defence should both primary and back-up transformers fail. However, it is important to be aware of these issues in the wider context of the electrical system and particularly the reliability of the HV Transformers. As mentioned above, failure of HV transformers increases dependence upon standby generation.
71. Of the 18 LV switchboards and MCCs surveyed, four are feeding Compressor Units which will cease operation by 2030. Another feeds Unit 2A which is due to cease operation at the end of 2023 in compliance with emissions legislation. These were found to be in suitable condition for this timescale and therefore do not need investment. A further two (and an additional one not included in the survey scope) are associated with compressor units which have been confirmed as redundant. However, the remaining 11 were identified as requiring replacement to eliminate safety issues and defects as well as addressing obsolescence issues.
72. Of the Distribution Boards surveyed, 61 were found to have asset health issues which need to be addressed. This would also have the benefit of removing asbestos and obsolescence issues.
73. Therefore, the electrical system of St Fergus is generally in need of investment to address issues across the majority of its assets as highlighted in Figure 11.

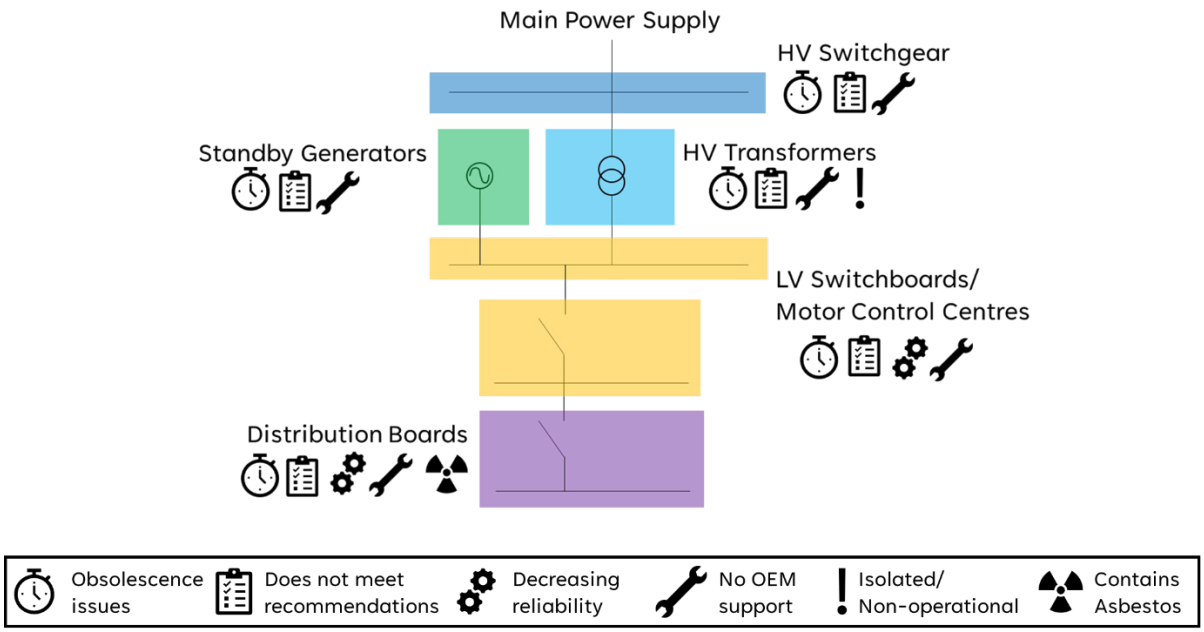

Figure 11 – Asset Issues across St Fergus Electrical System

Electrical Resilience

74. Similarly, to the compression assets, resilience is built into the design of the electrical systems to ensure continued operation. Table 4 summarises the resilience in each asset type.

Asset Type	Resilience
HV Switchgear	The two sets of seven panels provide resilience as the three plant areas can each be supplied through either side of the HV switchgear.
HV Transformers	Each of the three plant areas is served by two transformers which provides resilience when one must be taken out for maintenance or repair. Additionally, Plants 1 and 2 can be electrically interconnected to share transformers as a short-term measure.
LV Switchboards/MCCs	Resilience is achieved within the majority of the switchboards by their two-sided design, with the possibility of isolating either side without impacting the assets being supplied.
Standby Generators	Each of the generators associated with Plant 1 and 2 have the capacity to supply both plants, thereby acting as back-up for each other. However, the generator supplying the MTB does not have any back-up.
Distribution Boards	These do not have inbuilt resilience but rely upon a low risk of failure when in good condition and resilience is achieved by duplication of the assets being supplied where appropriate.

Table 4 – Resilience by Electrical Asset Type

75. Each of the electrical assets discussed plays a key role in ensuring continued electrical supply to the compression assets or the site in general. Therefore, it is important that they meet reliability, availability and maintainability requirements. This is currently at risk due to the condition of these assets, primarily due to their age. Loss of electrical supply can result in a loss of compression which has wider implications for consumers and security of supply for the UK.

Pipework and Valves

76. Another key system on site is the combination of pipework (both above and below ground) and valves. The pipework allows the natural gas to be transported between the various other assets process, flow-control, pressure control, gas quality, compression, metering, scrubbers, and pipework inspection equipment. The valves allow safe isolation of sections of the site in order for work to be carried out.

77. An illustration of the complexity of the station pipework and paint area boundaries (1-6) of the terminal is shown in Figure 12.

Figure 12 – St Fergus Terminal below and above ground pipework in each area

78. There is approximately 5.5 km of above ground pipe work ranging in different diameters from 1 to 48 inches connected with 19 km of below ground pipework.

Above Ground Pipework

79. Pipework coating provides a barrier between the parent pipework and its environment to prevent corrosion from occurring. Corrosion has been highlighted as being the single biggest life limiting mechanism affecting the pipework at St. Fergus.
80. The design, construction, operation, and maintenance of the above ground pipeline is subject to both the Pressure System Safety Regulations 2000 (PSSR) and the Pipeline Safety Regulations 1997 (PSR).
81. The external inspection and subsequent remediation of pipework defects or "features" to industry standards (IGEM TD/1), supplemented by NGT policies and procedures is accepted by the Health and Safety Executive (HSE) as an appropriate way of operating a safe above ground pipework asset and complying with required legislation.
82. NGT uses a defined methodology and specification for the visual inspection of paint, coating, and cladding for above ground assets (CM/4). The CM/4 inspections are undertaken for all above ground pipework assets every six years. Each inspection result is categorised on a scale of 1 to 6.
83. Following an inspection, those assets in categories 4, 5 or 6 are subject to further investigation where increased inspection and monitoring requirements and a maximum intervention period is defined followed by an assessment which includes non-destructive testing and/or removal of paint to assess the corrosion loss. Depending upon the asset concerned and the severity of the potential defect, this may require pressure reduction.
84. Following the assessment, a decision is then made against defined NGT policies to determine the intervention that is required which may include cut out and replace, repair, recoat, composite wrap/ or clamps.
85. The inspection regime, timing and defect categorisation is designed to ensure that a defect should not move more than one category between each inspection.
86. This balances the effective monitoring of corrosion, the mitigation of risk of increasing corrosion and the costs of inspection.
87. Above ground assets exposed to the atmosphere at St Fergus terminal have been experiencing and will continue to experience accelerated degradation of their protective coating and experience early onset of corrosion.
88. The painting applied to above ground pipework serves as the primary corrosion protection system. Typically, coating on above ground pipework is designed to be effective for a period of 10 to 15 years.
89. However, their deterioration at the terminal is accelerated by saliferous environment which enhances the mechanical degradation of the coating system.

This is evidenced from corrosion defects that have been observed on various above ground pipework across the terminal painted as early as 6 years ago.

Below Ground Pipework

90. Buried pipework will also corrode, therefore other assets are in place to manage and mitigate this. As mentioned previously, the main time-dependent threat to adversely affect buried pipework's technical life, is external corrosion.

91. Pipeline Coating applied to the outside surface of the pipeline is the primary corrosion protection for all pipework. The coating of a pipeline is the first line of defence from external corrosion which is critical to minimise the likelihood of interruptions to the distribution of gas. However, no coating is flawless.

92. Therefore, Cathodic Protection (CP) is an effective complementary method to protect structures in a corrosive environment which is a recognised industry practice. Coatings are designed with a 40-year life and deteriorate with age, with each type having different rates and characteristics and presenting different issues for resolution. This results in an increasing reliance on the CP system to compensate and mitigate corrosion.

93. From excavations conducted following the remnant life study, it is clear that areas of coating are life expired which means that at this point the CP system should act as the primary protection method to ensure appropriate risk management.

94. CP is installed on all pipework at St. Fergus as secondary protection to prevent corrosion where the coating has failed.

95. The current site CP system was installed at the time of terminal construction in 1974 and has been operated constantly since then to provide the necessary protection to the buried pipework on site. In the intervening years, Variable Speed Drive compressors have been added, amongst other plant and equipment. All these changes and the general complexity of the St Fergus terminal impact the efficacy of the CP system.

96. Reports have demonstrated that the CP system is no longer protecting the buried pipework from the corrosive soil at the site.

Valves

97. There are over 1,700 valves with diameters ranging from 1" to 36" installed on the terminal, serving a variety of purposes.

98. Valves may be manually operated, automatic or remotely controlled depending on the purpose they serve. Valves fulfil the NGT operational and legal requirements of the Pipeline Safety Regulations (PSR) and Gas Safety (Management) Regulations (GS(M)R) to provide:

    - Effective isolation of sections of the terminal to allow safe working; and

- The ability to safely shutdown and isolate sections of the terminal in the event of an incident.

99. Inspections have identified 85 valves across the terminal that require intervention due to exhibiting issues such as significant leakage, and likely to have considerable deterioration inside the valve body. The population of valves is deteriorating due to age and wear, whereby, many valves cannot achieve the seal required to fulfil their primary function of effective isolation.

Valve Actuators

100. A site wide valve actuation system powered by a single gas actuating pipework operates numerous safety valves, emergency shut down systems, vent systems, automated start-up and shut down processes and isolation valves.

101. In total the gas actuating pipework system currently provides the power for the operation of 143 gas-hydraulic Shafer Actuators across the terminal, critical to its safe operation.

102. The gas actuating pipework configuration was designed and built as part of the original terminal development in 1977 and has been in operation since. The pipework configuration stretches approximately 5.6km and is largely buried.

103. Maintenance and investment have been unable to keep up with the growing number and severity of defects on the Actuator pipework. This is partly because this pipework is not designed well to allow for maintenance. Therefore, maintenance activities require substantial isolations which are not readily available and are disruptive to operations.

104. The actuation system at St Fergus presents a range of significant risks that must be mitigated in full, and this has been duly recognised by the HSE.

5. Supply and Demand Scenarios

105. Across our investments, we have used the 2021 Future Energy Scenarios (FES). More detail on why this has been selected and the use of different scenarios within the Cost Benefit Analysis is captured within both the St Fergus Emissions FOSR and our CE-AMP.

106. Figure 13 shows the maximum supply flows at St Fergus for each of the FES 2021 scenarios. Although there is expected to be a fall in the maximum expected supplies in all scenarios, the supply levels are still significant, demonstrating the continuing need for capability at St Fergus out to and beyond 2050. Any investment at St Fergus will need to consider the wide range of potential flows that could arise over time, from low to high.

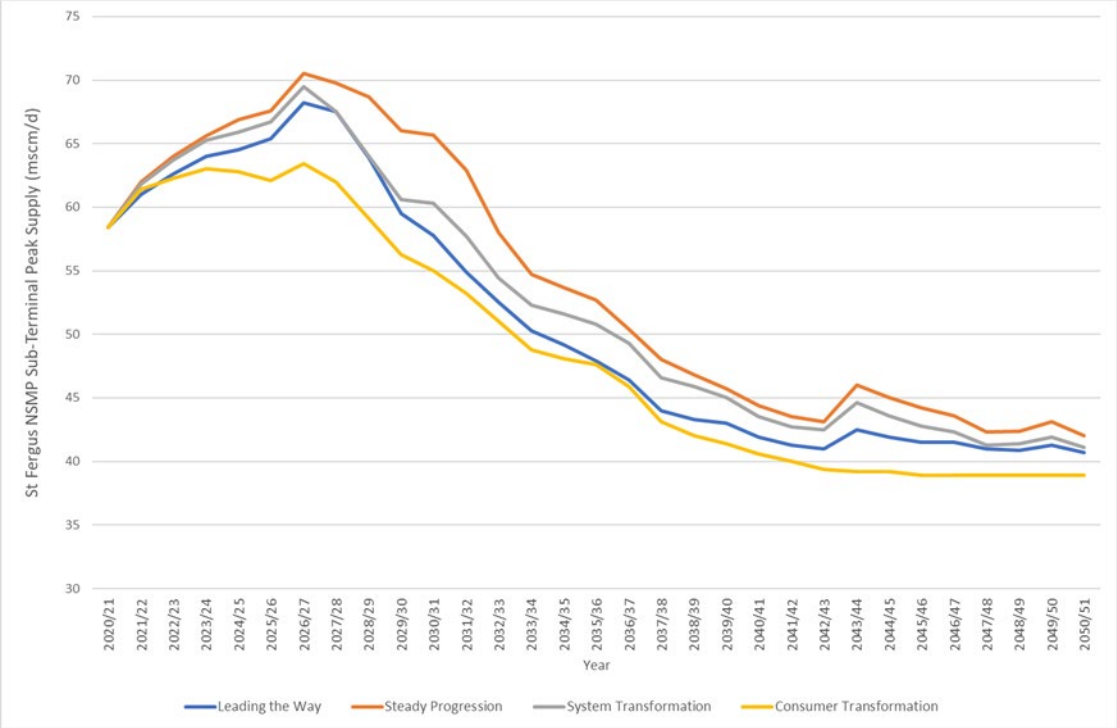

Figure 13 – Peak day St Fergus NSMP Sub-Terminal Supply FES 2021

107. In addition to analysis of the FES data flows, we have also undertaken stakeholder engagement with NSMP[4], who own the sub-terminal, to determine the rationale behind their expected flows and to corroborate the flows expected through their sub-terminal. Following detailed discussions with NSMP it has been determined that the likely flow range for the sub-terminal out to 2041 will be in the range 8 to 75 mcm/d (Figure 14); this full flow range will need to be accommodated by the compression available at St Fergus, and so a range of compression capability will be required to deal with the range of expected flows

[4] See Appendix R – Stakeholder Engagement Log

from low to high. The findings of the engagement with NSMP were summarised in a report included with the FOSR submission in January 2023.

Figure 14 - NSMP Peak flow projections

108. The peaks calculated by the FES process (Figure 13) are conservative when compared to the view provided by NSMP (Figure 14) which is informed by the producers who utilise the terminal. [redacted] This supports using FES 21 to set a conservative high case while still providing a sensible low case to model the likely future compression requirements.

6. Long-Term Strategy

Emissions Compliance Investment

109. Following a detailed option selection process, including an extensive stakeholder consultation programme, we have determined that St Fergus requires four compliant units across Plant 1 and Plant 2 by 2030. Four units provides the required capability to be able to manage a range of differing network flows, whilst having these units split across two Plants provides the necessary resilience should there be planned or unplanned circumstances that render some of the units unavailable.

110. The difference in capability across a sample of the options considered is shown in Figure 15. The option of 'Do nothing' for this project, is defined as the 'Counterfactual' within the FOSR. This is where no action is taken, other than asset health works, and Units 1A,1B, 1D and 2B are operated under Emergency Use Derogations (EUD). All other considered options are then compared to this option.

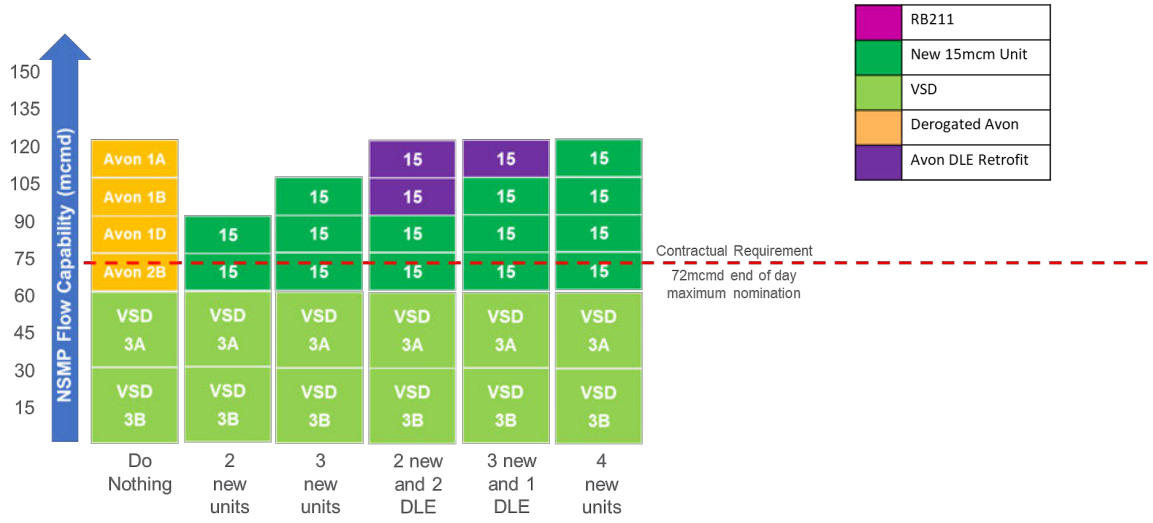

Figure 15 – Site capability under different potential long-term options

111. We have been working collaboratively with [redacted] to progress a prototype of Dry Low Emissions (DLE) retrofit technology. Subject to the results of ongoing testing, we are proposing to DLE retrofit one existing St Fergus Avon unit to further test the suitability of this technology on the NTS. St Fergus would allow testing of DLE retrofit on a high utilisation site, with reduced risk if failure occurs. This is because, we would still be able to utilise the existing Avon compressors for up to 500 hours each should we not be able to prove the DLE technology's reliability on our specific machines Avon.

112. If the DLE retrofit unit proves unsuccessful we will reassess the options to achieve a fourth compliant unit, utilising the existing compressors as emergency back-up. More detail on this is included within the Emissions FOSR.

113. Our preferred option of four unrestricted units (three new units and one DLE retrofit trial unit) represents the optimum solution for both achieving emissions compliance, ensuring the long-term Security of Supply of the UK and delivering value for consumers. The indicative total project value is [redacted].

114. More information on this recommendation is available in our Emissions FOSR. On 2 June 2023 Ofgem launched a consultation on their proposal to accept our Final Preferred Option.

Asset Health Investment

115. Given that the site will continue operating to at least 2050, there are also Asset Health investments which will be needed to ensure continued, reliable operation for that duration. These are investments which would likely not be prioritised if the site were only needed up to 2030, and therefore they are driven by the long-term strategy rather than the short-term strategy. Investments which are critical for continued operation up to 2030 and beyond are covered in the Short-Term Strategy section.

116. The following investments are important to carry out within RIIO-T2 because they form part of the wider electrical system, some of which urgently needs to be replaced and there are efficiencies to be gained by addressing these assets as a collective. This ensures successful interaction between them and minimises the overall cost of delivery.

LV Switchboards and MCCs

117. The LV switchboards and MCCs are developing increasing numbers of defects, becoming unreliable and obsolete leading to difficulty in locating spares. Therefore, we are recommending replacement of 11 out of the 18 LV switchboards and MCCs surveyed.

HV Switchgear

118. The HV switchgear does not meet the latest safety standards as its design lacks certain key features. Also related to its age, there is an increasing difficulty in locating spare parts. Therefore, we are recommending replacement of the HV switchgear.

7. Short-Term Strategy

119. In September 2021, a Short-Term Strategy, included in Appendix 1, was agreed which could guide our decisions in the absence of certainty on the long-term proposals for the site which would not be confirmed until the completion of our St Fergus Emissions UM submission in January 2023. This strategy was then updated in March 2022 and provided to Ofgem along with drafts of our Asset Health EJPs. This section has now been updated in light of the Emissions submission and Ofgem consultation position as well as to incorporate additional investments.

120. The key recommendations of our Short-Term Strategy to maintain site operation were as follows:

- Retain Flexibility of Options for the Future
- Maintain Site Safety and Integrity
- Maintain Terminal Operability
- Maintain Compression Availability

121. These recommendations will be covered in a more detail below, indicating relevant investments from both the January 2023 and June 2023 Asset Health submissions. Full details on these investments is available in their respective Engineering Justification Reports.

Short-Term Strategy Recommendation		Retain Flexibility	Maintain Site Safety	Maintain Terminal Operability	Maintain Compression Availability
Associated Investments	January 2023	Cyber OT	Unit Decom. (2C and 2D)	Valve Actuators	Plant 1 Aftercooler
		Emissions Compliance	Cathodic Protection		Avon Operability and Availability
	June 2023		Cabs Asbestos Mitigation	HV Transformers	Plant 2 Aftercooler
			Distribution Boards	Priority Valves (Phase 1)	
			Above Ground Pipework Corrosion		

Table 5 – Summary of alignment of investments with Short-Term Strategy Recommendations

Retain Flexibility of Options for the Future

Emissions Compliance

122. Until the results of the Preliminary Feasibility Study were available for the proposed investment to ensure emissions compliance, we could not be certain how many Avons would be required for the long-term site solution.

123. Therefore, retaining all five Avons allowed the maximum flexibility of options for our long-term site solution. It particularly allowed for potential options which reuse our existing assets such as derogating, retrofitting Dry Low Emissions (DLE) technology or implementing Control System Restricted Performance (CSRP) measures.

Cyber Operational Technology (OT)

124. [redacted]

125. [redacted]

126. [redacted]

Maintain Site Safety and Integrity

Unit Decommissioning (2C and 2D)

127. Work is needed urgently to ensure the site is safe. Concerns were raised, primarily about the condition of cladding known to contain asbestos on Units 2C and 2D, as well as the general civils condition of these unit exhaust stacks.

128. Therefore, the recommendation is to:

- Remove the current risk to site staff by demolishing Units 2C and 2D due to safety concerns around the cladding containing asbestos. This was covered in the St Fergus Unit Decommissioning EJP in January 2023.

Cabs Asbestos Mitigation

129. The same asbestos containing cladding is also present on all Plant 1 units and therefore they also pose a safety risk. Unit 1C is no longer needed in any scenario

but Units 1A, 1B and 1D will be required until the new units have been commissioned and proven with one Avon being retained long-term if the Dry Low Emissions retrofit technology is proven.

130. Therefore, the recommendation is to:

- Reduce the current risk to site staff by demolishing Unit 1C and mitigate the asbestos present on Units 1A, 1B and 1D. This is covered in the St Fergus Cabs Asbestos Mitigation EJP. We aim to bundle this decommissioning in with the 2C and 2D decommissioning for efficiency.

Distribution Boards

131. Another asset containing asbestos are fuse holders within some of the distribution boards. This is in addition to other issues posed by the distribution boards such as reliability, availability of spares and outdated design.

132. Therefore, the recommendation is to:

- Remove the current risk to site staff by replacing 61 Distribution Boards. This is covered in the St Fergus Distribution Boards EJP.

Cathodic Protection

133. Another risk on site is presented by the condition of the current Cathodic Protection (CP) system and pipework coating. This presents safety and operational risks to both site personnel and site operations as it is no longer protecting the buried pipework from the corrosive soil at the site.

134. Therefore, the recommendation is to:

- Assure continued integrity and safety management of buried pipework by replacing the CP system. This was covered in the St Fergus Cathodic Protection EJP in January 2023.

Above Ground Pipework Corrosion

135. St Fergus has significant amounts of above ground pipework which experiences accelerated degradation of its protective coating and subsequent corrosion due to the coastal location. Previous reactive remediation of corrosion has been expensive and disrupted normal operation of the site. The corrosion currently present on site presents a significant risk to its operation and must be addressed, but a more proactive approach is also needed to reduce future corrosion.

136. Therefore, the recommendation is to:

- Remove the current risk posed by corrosion by resolving existing and forecast CM/4 defects and remediating corrosion defects on pit wall transitions.

- Also, to reduce future corrosion by initiating site wide painting to prevent further deterioration of above ground pipework. These are covered in the St Fergus Above Ground Pipework Corrosion EJP.

Maintain Terminal Operability

Valve Actuators

137. The condition of the single feed pipework configuration presents safety and operational risks to both site personnel and site operations due to many critical external corrosion defects and threats from ground movement which has the potential to damage the associated actuator pipework.

138. A failure or isolation of the gas actuating pipework eliminates valve actuation operation of up to 143 valves and can render the terminal inoperable, with the natural gas supplied by the ring-main required to provide each actuator with a power source to move to a safe position.

139. Therefore, the recommendation is to:

- Ensure continued operation of the wider terminal by delivering the actuator replacement programme. For more information, see the St Fergus Actuators EJP submitted in January 2023.

HV Transformers

140. Site inspections of the six legacy HV transformers have identified multiple condition related defects and three of these (one for each area) have had to be electrically isolated due to oil leakage caused by severe corrosion of the tanks.

141. This has left each area currently running on its back up option and therefore more reliant on the use of a standby generator for back up should any of the transformers fail.

142. Therefore, the recommendation is to:

- Ensure continued, resilient provision of electrical supply by replacing all six legacy HV transformers.

Priority Valves (Phase 1)

143. Site inspections identified 85 valves which require intervention as they exhibit significant leakage and are likely to have considerable deterioration inside the valve body.

144. This has made it increasingly complex to achieve safe isolations which are required to carry out other planned interventions. The additional complexity increases the duration and cost of these works.

145. Therefore, the recommendation is to:

- Improve ability to achieve safe isolations to facilitate ongoing works and general site operation by replacing 20 priority valves in alignment with RIIO-T2 planned outages; and replacing the remainder in RIIO-T3.

Maintain Compression Availability

Avon Operability and Availability

146. There are currently three operational Avons on the site. After 2A ceases operation, there would not be sufficient resilience in the event of a Plant 3 outage or general breakdowns during delivery of capital works. This was confirmed through a Cost Benefit Analysis which is detailed in Appendix 1 – Short Term Strategy Cost Benefit Analysis.

147. Therefore, the recommendation is to:

- Ensure there are four operational Avons by carrying out cab infrastructure work to reinstate Unit 2B. This was covered in the St Fergus Avon Operability and Availability EJP submitted in January 2023.

Plant 1 Aftercooler

148. Inspections on the Plant 1 Aftercoolers identified gas leaks and subsequent activities highlighted significant corrosion and wider age-related equipment defect issues.

149. The aftercooler plants provide the necessary cooling to prevent downstream asset integrity issues within the St Fergus Terminal buried pipework area and our downstream feeder mains pipelines. The aftercoolers have been operating for over 47 years in a remote coastal environment, against an Original Equipment Manufacturer (OEM) design-life expectancy of 25 years.

150. Therefore, the recommendation is to:

- Facilitate ongoing security of supply by replacing the required elements of Plant 1 aftercoolers. This was covered in the St Fergus Plant 1 Aftercooler EJP submitted in January 2023.

Plant 2 Aftercooler

151. The Plant 2 Aftercooler is exhibiting similar integrity defects as those seen on Plant 1.

152. Therefore, the recommendation is to:

- Facilitate ongoing security of supply by completely replacing the Plant 2 Aftercooler. This is covered in the St Fergus Plant 2 Aftercooler EJP.

Summary

153. Based upon the analysis carried out and the Final Preferred Option for emissions compliance, the recommended strategy for each compression plant is summarised in Figure 16.

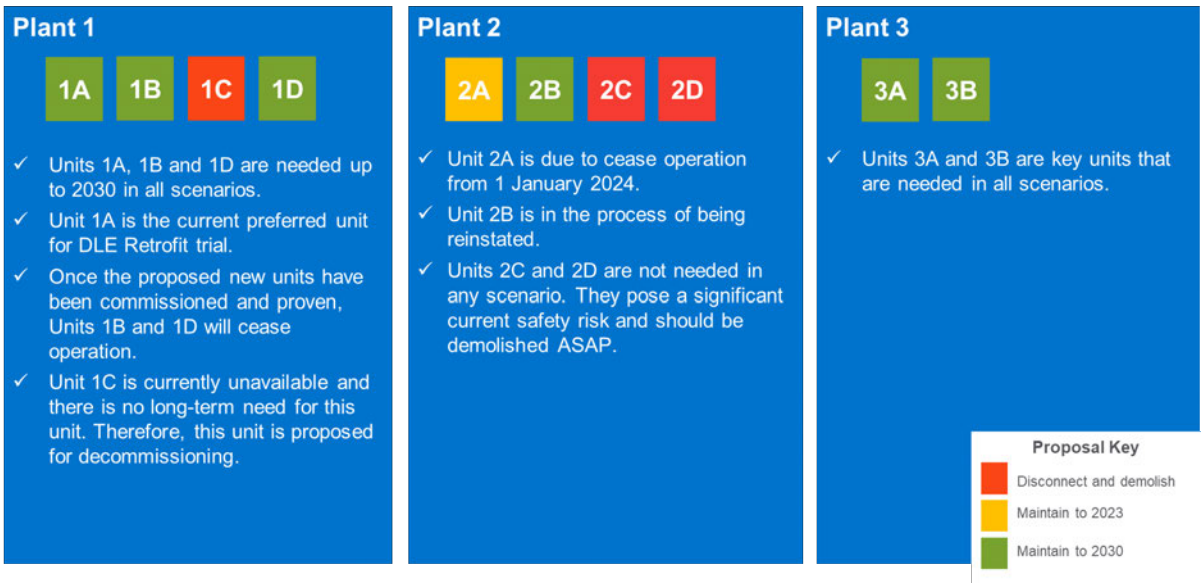

Figure 16 - Recommended Strategy by Unit

8. Challenges

154. The unique operating conditions at St Fergus present certain challenges to capital investment projects necessary to ensure it is fit for purpose out to 2050. Due to the terminal's need to operate 24/7/365 there are key factors that influence investment decisions.

Outage Availability

155. Outage availability presents the biggest challenge. Even with mitigating factors like Emergency Return to Service agreements and the resilience afforded by having multiple plants there are operational situations where outages must be withdrawn or reallocated to higher priorities at short notice. This necessitates a reappraisal of both the capital investment and maintenance plans to maintain optimal use of outages and not lose opportunities to deliver works efficiently and economically.

156. With the level of investment required at St Fergus out to 2030, including the significant work required to comply with Emissions legislation, there is a constrained timeframe within which to deliver these works nested inside the outage framework.

Resource Availability

157. The isolated geographical location of the Terminal adds a level of complexity to investment delivery that has an impact on sourcing and retaining appropriately skilled and experienced construction teams.

158. In the last two years, global economic conditions have conspired to affect lead times for certain materials and parts (e.g. valves) and inflationary pressures have had a significant impact on all the costs of delivering infrastructure projects.

Option Costing

159. Ideally, all investments would have a range of viable options fully costed to enable a well justified recommended option. In many of the current investments however, the age of the assets involved means that the OEM no longer exists making it extremely difficult to source a quote for refurbishment options. This is often because contractors are not willing to price the work due to the complexity involved in combining new parts with old equipment.

160. In the case of the currently proposed electrical investments, the time and cost that would be required to source a reliable quotation for these works was not deemed to add value when the refurbishment options were discounted due to the following points:

- It would not remove risks posed by out-dated designs of some assets (e.g. Arc-flash and protection from live components).

- It would not remove asbestos, where present, which poses an occupational health risk to those in the vicinity.
- It would not address obsolescence issues which affect the ongoing reliability, availability and maintainability of terminal assets.
- It would not meet the ALARP requirement to use 'best-practice' standards.
- It would require a longer outage than replacement which increases the challenge of maintaining an operational site while the work is completed.

9. Interaction Between Investments

161. With such a complex site and so many investments planned, it is crucial that we understand the interactions between these investments and ensure there is no duplication across funding requests.

162. A clear breakdown of the specific works proposed for the compressor emissions, subsidence and asset health projects for the site is provided in Appendix 3. Where there are interactions between investments, these are outlined in Table 6.

163. We are confident that there is no duplication between funding requests and that any interdependencies between projects have the required visibility to project delivery teams.

Interacting Investments		Notes
Emissions Compliance	Unit Decommissioning	The Emissions CBA has included the cost of decommissioning existing units where that is necessary in order to construct new ones therefore our preferred option includes the decommissioning of three existing units. It is likely that, due to the layout of the units, this would include Unit 2D however this unit will already have been removed. There will be no duplication of funding request as this will be submitted in the cost reopener by June 2025 based upon detailed design. This also does not impact the CBA results as the immediate decommissioning of Units 2C and 2D would be applied equally across all options considered.
Emissions Compliance	Low Voltage (LV) Switchboards	Some of the LV switchboards due for replacement are associated with compressor units which may or may not be retained in different long-term options and therefore the cost of those replacements has been included within the Emissions CBA in order to inform option selection. However, the cost of those replacements will only be included in the Asset Health funding request where required.
Emissions Compliance	Cabs Asbestos Mitigation	There is a short-term requirement to address cladding containing asbestos on Units 1A, 1B, 1C and 1D. The current proposal to make these safe for continued operation to 2030 by repainting them, replacing the cladding or decommissioning if no longer required. Where units are decommissioned and that space is later used for construction of new units, that decommissioning cost will not also be requested through the emissions project.
Emissions Compliance – DLE Retrofit Trial	Broader Asset Health scopes	The preferred unit for the DLE retrofit trial is Unit 1A in order to provide balance of plant and appropriately spaced units. Therefore Unit 1A is suitable for investments which prolong its life to 2050 rather than simply to 2030.
Avon Operability and Availability	Valve Actuators	The scope developed for replacement of actuators includes eight associated with each compressor unit. This includes those associated with Unit 2B which is planned to be returned to operation as part of the Avon Operability and Availability investment. The replacement of actuators associated with Unit 2B will only be part of the actuator investment scope but the two projects are connected and if any change is made to the Avon Operability scope then it could impact the Actuator investment.

Interacting Investments		Notes
Avon Operability and Availability	Broader Asset Health scopes	There will be no duplication of costs across these investments however scopes will have to be closely checked to ensure assets associated with Unit 2B are included in scopes where required to support its operation to 2030 once it has been returned to operation.
Unit Decommissioning	Broader Asset Health scopes	A review has been undertaken of all the Asset Health scopes to identify anything that can now be removed due to the planned decommissioning of these units. For example, LV switchboards or MCCs associated with Units 1C, 2C or 2D are not included in the scope for replacement.
Cabs Asbestos Mitigation	Broader Asset Health scopes	With the recommendation to decommission Unit 1C, associated assets (e.g. LV switchboard) are not included in any of the other Asset Health investment scopes.
Plant 2 Aftercooler	LV Switchboards and MCCs	One of the LV switchboards proposed for replacement is associated with the Plant 2 Aftercooler. This work will only be captured within the switchboards investment and not duplicated through the proposed replacement of the aftercooler.

Table 6 – St Fergus Investment Interactions

10. Conclusions

164. St Fergus Gas Terminal is fundamental to UK Security of Supply. The terminal has been in continuous operation for over 40 years and requires a level of investment to both re-life assets on the terminal and make compressors, that receive gas from the North Sea Midstream Partners (NSMP) sub-terminal, compliant with environmental legislation.

Emissions Compliance

165. Through the St Fergus Emissions Uncertainty Mechanism submission, we proposed our preferred option for compliance with emissions legislation. Our preferred option is four unrestricted units (three new units and one DLE retrofit trial unit). This option represents the optimum solution for both achieving emissions compliance, ensuring the long-term Security of Supply of the UK and delivering value for consumers. For more detail on these investments see the St Fergus Final Option Selection Report (FOSR).

Subsidence

166. As part of the Feasibility process, we have determined that there is not a site wide subsidence issue that will affect future operation. There is evidence of localised occurrences of subsidence, therefore we plan to request upfront funding for detailed survey and optioneering through the next Asset Health UM Submission window of January 2024. This will then provide the basis for a baseline funding request in our RIIO-T3 submission.

Asset Health

167. Through the Asset Health January 2023 UM, we proposed various investments which will ensure the continued, safe operation of the site until 2030. As a result of engagement with Ofgem through FY21, it was agreed that National Gas Transmission (NGT) will utilise the Asset Health Reopener Submissions to request funding for these and further Asset Health investments.

168. We communicated with Ofgem that our proposed solutions for some asset health works had commenced resulting in a submission that represented a request for funding of costs incurred to-date and then requesting allowances for the remainder of the works. Those investments covered Valve Actuators, Plant 1 Aftercoolers, Cathodic Protection System, Unit Decommissioning (2C and 2D) and work to restore a fourth Avon unit to operation. For more detail on these investments, see each corresponding Engineering Justification Paper (EJP) submitted in January 2023.

169. These are now being supplemented by additional investments covering Plant 2 Aftercoolers, Priority Valves, Above Ground Pipework Corrosion, HV Transformers,

HV Switchgear, LV Switchboards and MCCs, Distribution Boards and Cab Asbestos Mitigation.

170. Many of these investments are operationally critical and all are important to begin in RIIO-T2 to ensure efficient delivery. The key proposal and cost of each is summarised in Table 7.

Product Name	Proposal	Total Cost (£m, 18/19)	Funding Request (£m, 18/19)
St Fergus Cabs Asbestos Mitigation	Demolish Unit 1C and mitigate the asbestos present on Units 1A, 1B and 1D.	[redacted]	
St Fergus HV Transformers	Replace all six legacy HV transformers		
St Fergus Above Ground Pipework Corrosion	Resolve existing and forecast CM/4 defects and remediating corrosion defects on pit wall transitions. Initiate site wide painting.		
St Fergus HV Switchgear	Replace the HV switchgear		
St Fergus Priority Valves (Phase 1)	Replacing 20 priority valves in RIIO-T2		
St Fergus Plant 2 Aftercooler	Replace the Plant 2 Aftercooler		
St Fergus LV Switchboards and MCCs	Replace 11 out of the 18 LV switchboards and MCCs surveyed.		
St Fergus Distribution Boards	Replace 61 Distribution Boards		
St Fergus Asset Health June 2023 Total		[redacted]	**85.190**

Table 7 – St Fergus Asset Health June 2023 Submission Investment Summary

11. Appendices

Appendix 1 – Short-Term Strategy Cost Benefit Analysis

File: RIIO-T2 St Fergus Short Term Strategy V7

Appendix 2 – Resilience Assessment

File: St Fergus Resilience Assessment v1.2

Appendix 3 – Investment Breakdown

Investment	Planned Funding Route	Specific Works Proposed
Redundant Assets	Baseline Funded	Removal of specific assets which are no longer required
Cyber	Cyber UM January 2023	[redacted]
Emissions Compliance	Emissions UM January 2023	Construction of three new units and implementation of DLE retrofit trial on an existing Avon
Valve Actuators	Asset Health January 2023 Reopener	The proposal is to deliver a replacement valve actuating system and associated auxiliary power supply cabling to each asset allowing electrical operation.
Plant 1 Aftercooler	Asset Health January 2023 Reopener	Replacement of the Plant 1 Tube Bank assembles, Aftercooler Frame support structure and associated electric motor driven fan assemblies.
Cathodic Protection Replacement Programme	Asset Health January 2023 Reopener	Replacement of the CP system.
Avon Operability and Availability	Asset Health January 2023 Reopener	Cab infrastructure works to reinstate one of the presently deteriorated Avon units (2B) prior to Dec 2023.
Unit Decommissioning	Asset Health January 2023 Reopener	The proposal is for investment for immediate demolition of Units 2C and 2D.
Plant 2 Aftercooler	Asset Health June 2023 Reopener	Paper providing justification and a funding request for complete replacement of Plant 2 Aftercooler.
Asbestos Cab Risk Mitigation	Asset Health June 2023 Reopener	Asbestos risk mitigation for Avon cabs on Plant 1 (Units 1A, 1B, 1C and 1D).
Above Ground Pipework Corrosion	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the remediation and prevention of CM/4 defects identified on above ground pipework through the routine and non-

Investment	Planned Funding Route	Specific Works Proposed
		routine maintenance activities at St. Fergus Gas Terminal.
Distribution boards	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the replacement of distribution board assets at St. Fergus Gas Terminal.
LV switchboards	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the optimum investments on LV switchboards and MCCs
HV transformer	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the replacement of the HV Transformers.
Valves	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the replacement of valves.
HV switchgear	Asset Health June 2023 Reopener	Paper providing justification and a funding request for the replacement of the HV switchgear.
Access road monitoring and replacement	Asset Health January 2024 Reopener/RIIO-T3 Submission	Refurbishment of the site's road infrastructure
Damaged and broken drainage asset replacement	Asset Health January 2024 Reopener/RIIO-T3 Submission	Replacement of drainage assets required to enable safe runoff of rainwater and sewage to appropriate locations all year round
Standby generators	Asset Health January 2024 Reopener/RIIO-T3 Submission	Replacement of standby generators which are passed their design life and face obsolescence
Vent system	Asset Health January 2024 Reopener/RIIO-T3 Submission	Replacement of vent system piping to ensure it is fit for purpose
Fire suppression	Asset Health January 2024 Reopener/RIIO-T3 Submission	Design, supply, installation, and commissioning of the fire suppression system
Fuel gas heating	Asset Health January 2024 Reopener/RIIO-T3 Submission	Replacement of the fuel gas heating system which is beyond its design life and no longer fulfils its design requirements to current safety standards.
Fire water ring main	Asset Health January 2024 Reopener/RIIO-T3 Submission	Replacement of the fire water system components to provide reliable firefighting capability until 2050.

Investment	Planned Funding Route	Specific Works Proposed
VSD access roof panel	Asset Health January 2024 Reopener/RIIO-T3 Submission	Modification of the VSD compressor cab to enable access by removing existing clad panels and installing electrically driven roof panels
Tanks and bunds	Asset Health January 2024 Reopener/RIIO-T3 Submission	Repair or replacement of the tanks and the associated bunds
Structural integrity	Asset Health January 2024 Reopener/RIIO-T3 Submission	Repair or replacement of significant structures
Lighting	Asset Health January 2024 Reopener/RIIO-T3 Submission	Refurbishment/replacement of Lighting system on site for safe operation
Site ducting	Asset Health January 2024 Reopener/RIIO-T3 Submission	Refurbishment/replacement of site ducting.
Lube oil systems	Asset Health January 2024 Reopener/RIIO-T3 Submission	Refurbishment/replacement of Avon lube oil systems

Table 8 – Breakdown of Asset Health Investments

12. Glossary

Glossary	
Avon	Rolls Royce (Siemens) gas turbine engine which forms part of the compressor machinery train and is subject to MCPD.
BAT	**Best Available Techniques:** The most effective and advanced stage in the development of activities and their methods of operation which indicates the practical suitability of particular techniques for providing the basis for emission limit values and other permit conditions designed to prevent (and where that is not practicable), to reduce emissions and the impact on the environment as a whole.
CBA	**Cost Benefit Analysis:** A mathematical decision support tool to quantify the relative benefits of each site option.
CE-AMP	**Compressor Emission Asset Management Plan**
Compressor Unit	Equipment used to compress gas to high pressure for transport through the NTS. Each compressor station consists of one or more compressor units as well supporting equipment such as meters, filters, valves and pipework. Compressor units can be driven by gas turbines or electric drives.
CP	**Cathodic Protection**
CSRP	**Control System Restricted Performance:** Technology that restricts the performance of a gas-driven compressor to limit NO_x emissions.
DLE	**Dry Low Emissions:** An Avon DLE retrofit modifies the combustion system within the Avon engine so that air and fuel are premixed before combustion. This reduces the peak combustion temperature, which in turn reduces the amount of NOx produced.
DNO	**Distribution Network Operator**
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 National Grid is obligated to make available for delivery against on every day of the year.
EUD	**Emergency Use Derogation:** Derogation provided under the MCPD for equipment used in emergencies and less than 500 hours per year on a rolling 5 year average, with a maximum limit of 750 hours in any one year.
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**
GT	**Gas Turbine**
HV	**High Voltage**

Glossary	
IED	**Industrial Emissions Directive:** An EU directive that came into force in January 2011.
LCPD	**Large Combustion Plant Directive:** An EU directive to reduce emissions from combustion plants with a thermal output of 50 MW or more. Combustion plant must meet the emission limit values (ELVs) given in the LCP directive for NO_x, CO, SO_2, and particles.
LV	**Low Voltage**
MCC	**Motor Control Centre**
MCPD	**Medium Combustion Plant Directive:** A directive to reduce emissions from combustion plants with a net thermal input between 1-50 MW.
MTB	**Main Terminal Building**
NEA	**Network Entry Agreement**
NGT	**National Gas Transmission**
NSMP	**North Sea Midstream Partners**
NTS	**National Transmission System:** The high-pressure system consisting of terminals, compressor stations, pipeline systems and offtakes. Designed to operate at pressures up to 85 barg. NTS pipelines transport gas from terminals to NTS offtakes.
OCB	**Oil Circuit Breaker**
OEM	**Original Equipment Manufacturer**
PTP	**Proof Testing Procedure**
RAM	**Reliability Availability Maintainability**
RB211	A Rolls Royce (Siemens) gas turbine engine which forms part of the compressor machinery unit and is subject to LCPD.
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.
SSEN	**Scottish and Southern Electricity Network**
UKCS	**United Kingdom Continental Shelf:** The region of waters surrounding the United Kingdom, in which the country claims mineral rights.
UM	**Uncertainty Mechanism:** Uncertainty mechanisms exist to allow price control arrangements to respond to change. They protect both end consumers and licencees from unforecastable risk or changes in circumstances.
VCB	**Vacuum Circuit Breaker**
VSD	**Variable Speed Drive**