Site Strategy

St Fergus Gas Terminal

January 2023

nationalgrid

Contents

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 to 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.

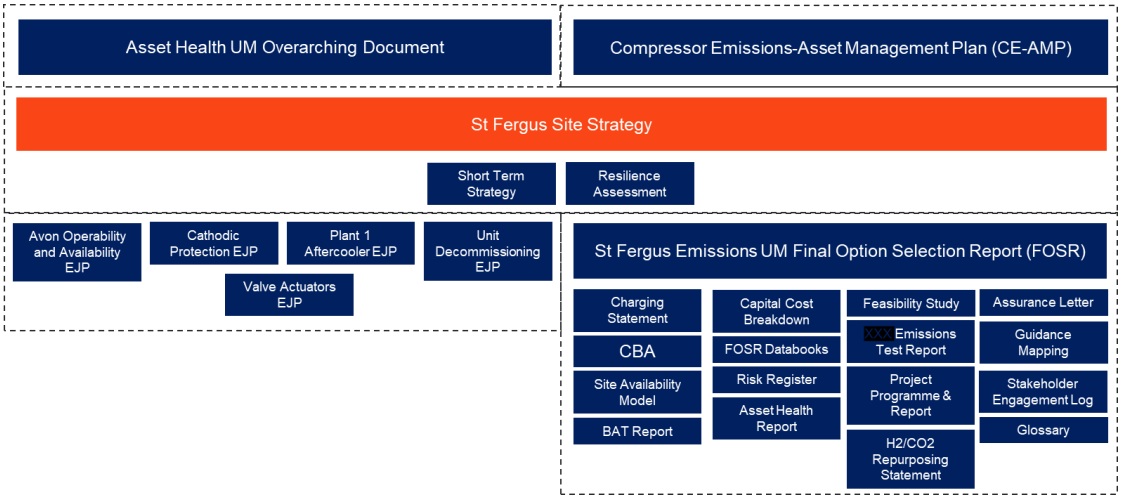

Figure 1: St Fergus Submission Documents Structure

3. This document 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. This document is part of a suite of documents shown in Figure 1. It is advised that this document should be read in conjunction with both the Emissions and Asset Health Uncertainty Mechanism (UM) Submissions.

Our Strategies

4. 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. Our St Fergus Short-Term Strategy 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.

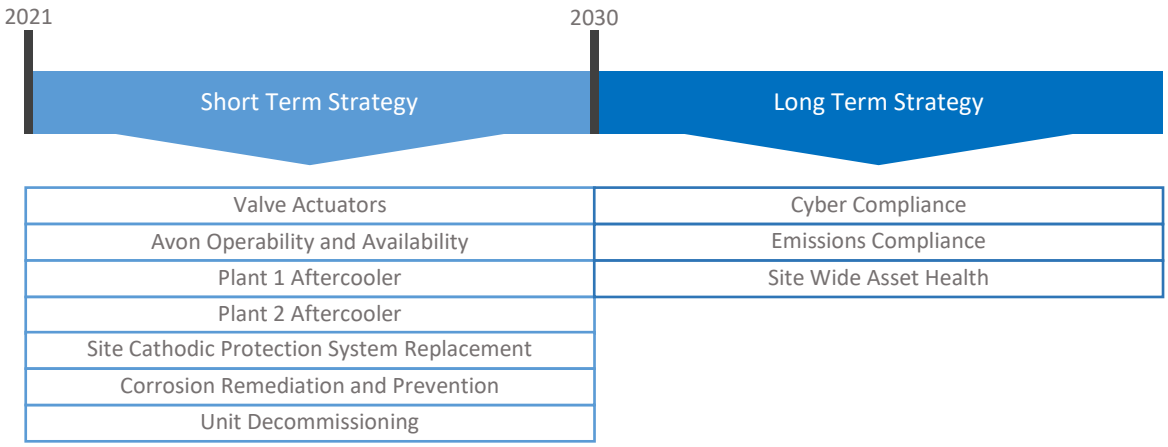

Figure 2 - St Fergus Strategies Summary

5. The St Fergus Short-Term Strategy document sets out the approach to rationalise the compression units across Plant 1 and 2 to just 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.

6. In support of these goals, five Engineering Justification Papers are being submitted through the Asset Health Reopener in January 2023 with more to follow in June 2023.

7. 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.

8. 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

9. Through the St Fergus Emissions Uncertainty Mechanism submission, we are proposing 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).

10. 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 June 2023. This will then provide the basis for a baseline funding request in our RIIO-T3 submission.

11. Through the Asset Health January 2023 UM, we are proposing 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 Grid Gas Transmission (NGGT) will utilise the Asset Health Reopener Submission to request funding for these investments. We communicated with Ofgem our proposed solutions for the asset health works have commenced resulting in a submission that represents a

request for funding of costs incurred to-date and then requesting allowances for the remainder of the works.

12. These investments cover Actuators, Plant 1 Aftercoolers, Cathodic Protection system, unit decommissioning and work to restore a fourth Avon unit to operation. For more detail on these investments see each corresponding Engineering Justification Paper (EJP). These will be supplemented by additional investments in the next Asset Health UM Submission window of June 2023 covering Plant 2 Aftercoolers, Corrosion Remediation, Asbestos and a variety of other scopes. These have been included as part of our rationalisation assessment and, where appropriate, as part of our Emissions FOSR Cost Benefit Analysis (CBA) costs. However, these scopes and costs are still in development.

Product Name	**Investment commenced at risk?**	**Draft submitted to Ofgem prior to January 2023 submission?**	**Total Cost (£m)**	**Funding Request (£m)**
St Fergus Actuators EJP	Y	Y	[redacted]	[redacted]
St Fergus Plant 1 Aftercooler EJP	Y	Y	[redacted]	[redacted]
St Fergus Avon Operability EJP	Y	Y	[redacted]	[redacted]
St Fergus Unit Decommissioning EJP	N	Y	[redacted]	[redacted]
St Fergus Cathodic Protection EJP	Y	Y	[redacted]	[redacted]
St Fergus Asset Health Total	***N/A***	***N/A***	***50.001***	***44.604***
St Fergus Emissions FOSR	N	N	[redacted][1]	N/A
St Fergus Emissions Total	***N/A***	***N/A***	[redacted]	*N/A*
ST FERGUS TOTAL	**N/A**	**N/A**	[redacted]	**44.604**

Table 1 – St Fergus Investment Summary January 2023 Submissions

Who Pays

13. 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 addressed further in 2023. See FOSR Appendix C – Charging Methodology for further information.

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

2. The Importance of St Fergus to the NTS

14. The St Fergus 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

15. The site operates 24/7/365, regularly supplying in the range of 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.

16. NGGT 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.

17. 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

18. 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.

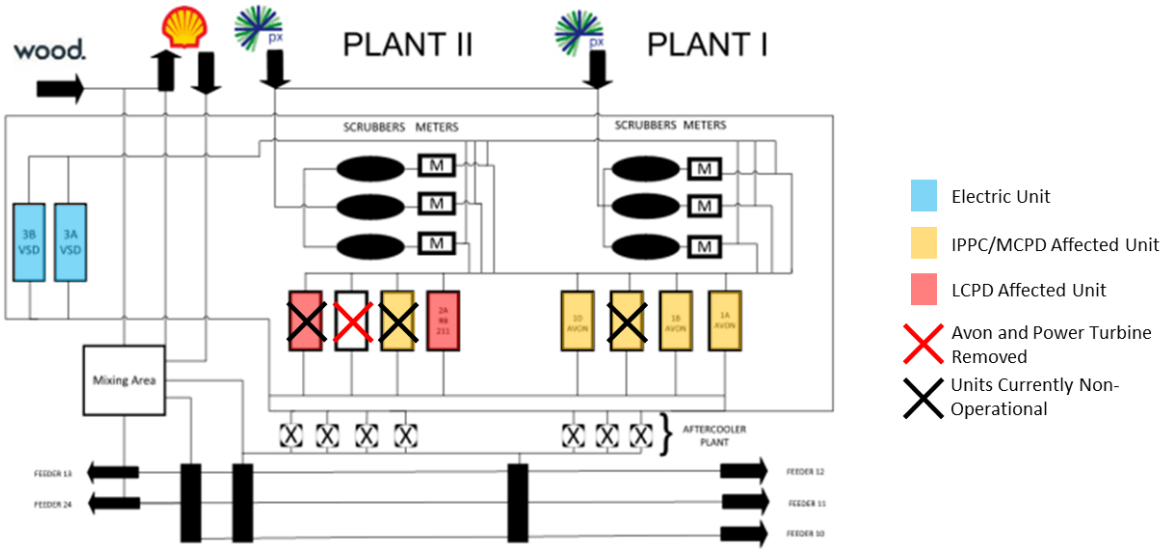

Figure 4 – St Fergus Terminal Site Layout

19. The compression on site is provided by either one of the gas compression units (mostly Avons and one remaining RB211) or the electrical Variable Speed Drive (VSD) units.

20. The terminal operates 24/7/365 and is not afforded regular outages from sub-terminals to undertake maintenance. Sections of Plant 1 and Plant 2 serve as redundancy for each other allowing NGGT to undertake statutory inspections and critical testing of our safety critical and emergency shutdown system 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.

21. 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. Current Compression on Site

Site Timeline

20. 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 5 are the key events in the history of site compression.

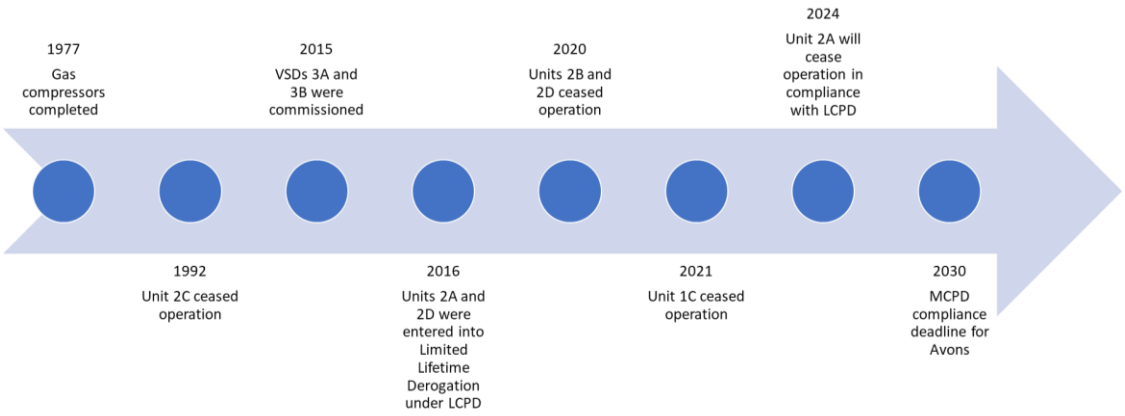

Figure 5 – Timeline of Key Compression Events at St Fergus up to 2030

Gas Driven Compressors

21. 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.

22. As highlighted in Figure 4, 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) for more information on the emissions legislation.

23. 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 must cease operation from 31 December 2023.

24. 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.

20. Unit 2B ceased operation in 2020. The Cab structure, outer cladding and exhaust are in a very poor state and would require major investment to bring it back to an operational state. The Power Turbine would need also need to be removed and overhauled along with work on the ventilation system.

21. 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.

22. 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

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

24. 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

25. 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.

26. 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 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.

27. These roles are summarised in Figure 6. 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.

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

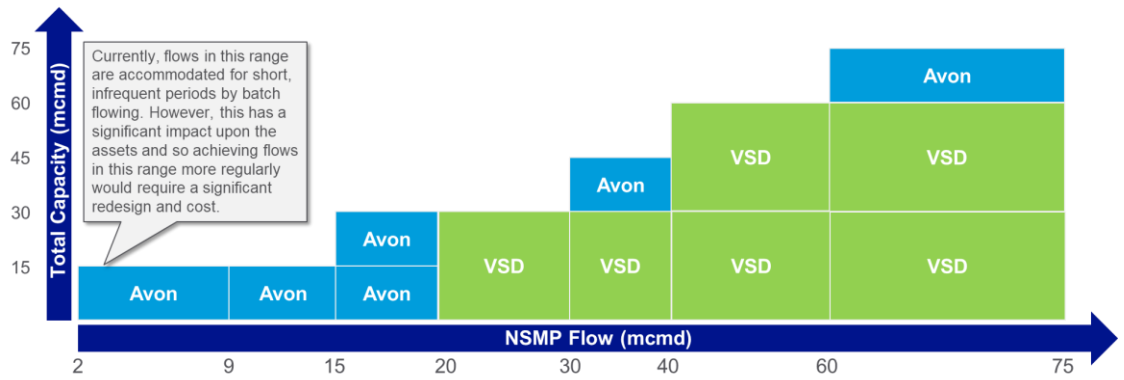

Figure 6 – St Fergus Unit Capability

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

Changing Capability Over Time

30. 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.

31. 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.

32. 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 7.

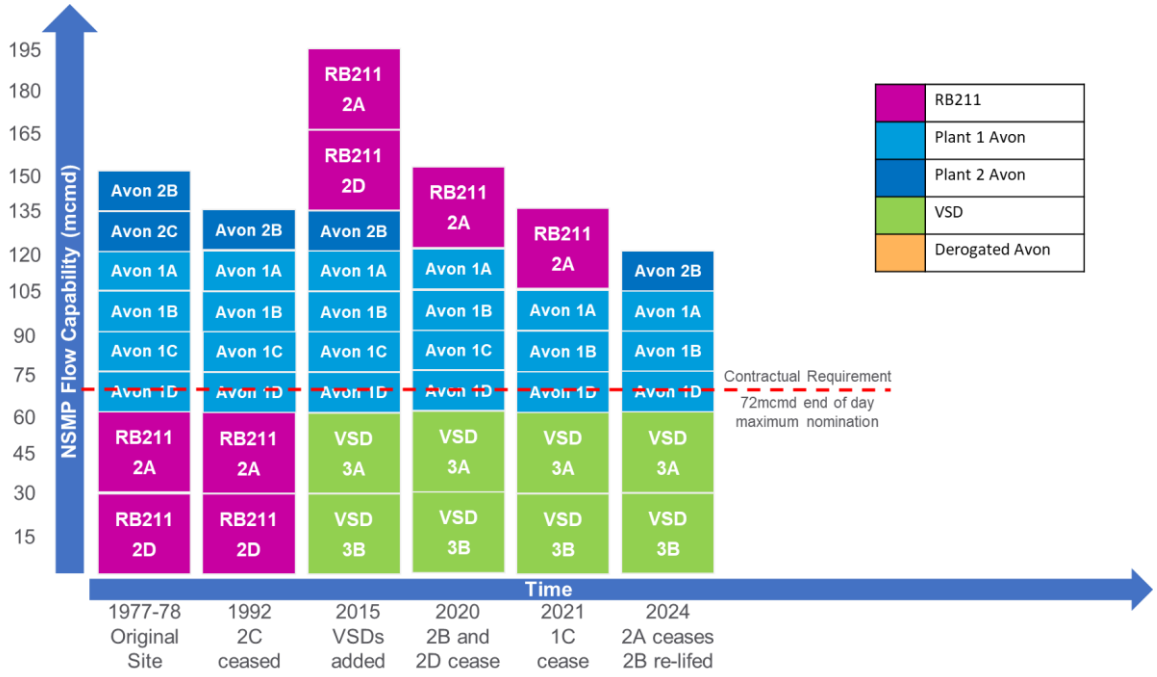

Figure 7 – Site Capability Changes up to 2030

33. 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.

Site Resilience

34. 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.

35. 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.

36. 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.

37. 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.

38. To ensure we are delivering the best value for our customers, we have 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.

39. 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.

40. 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.

41. 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 2 Summary of compression configurations analysed

5. Supply and Demand Scenarios

42. 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.

43. Figure 8 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.

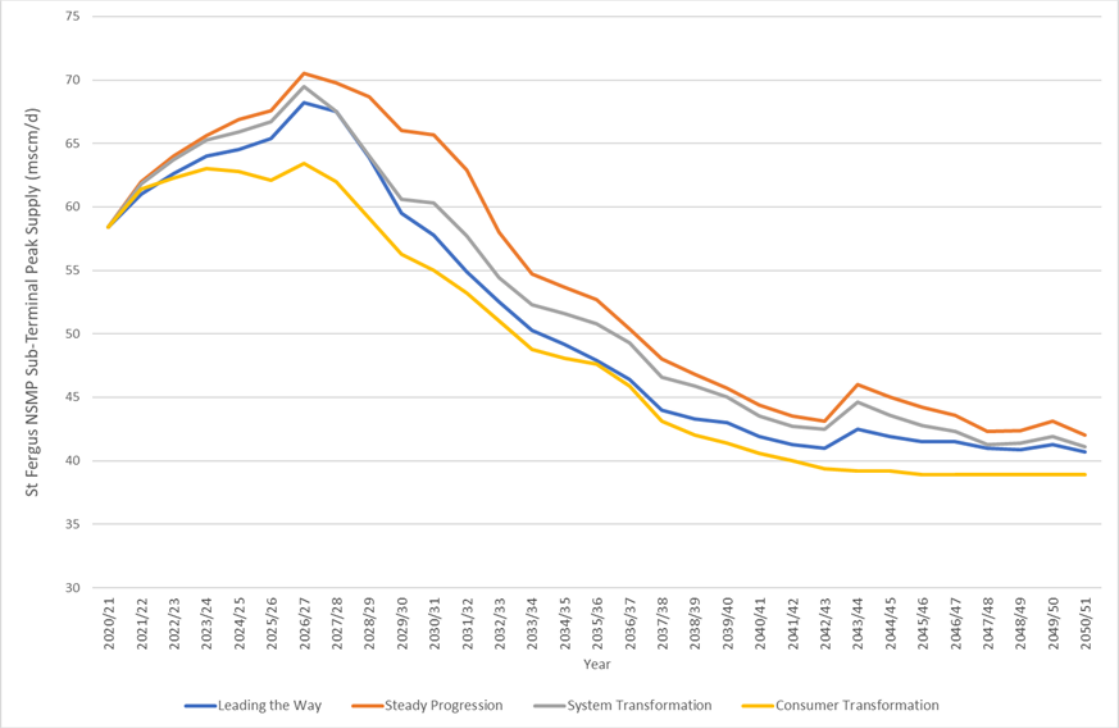

Figure 8 – Peak day St Fergus NSMP Sub-Terminal Supply FES 2021

44. In addition to analysis of the FES data flows, we have also undertaken stakeholder engagement with NSMP[2], 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 9); 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 from low to high. The findings of the engagement with NSMP have been summarised in a report, details of which can be found in Appendix R – Stakeholder Engagement Log.

[2] See Appendix R – Stakeholder Engagement Log

Figure 9 – NSMP Peak flow projections

45. The peaks calculated by the FES process (Figure 8) are conservative when compared to the view provided by NSMP (Figure 9) which is informed by the producers who utilise the terminal.

    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. Short-Term Strategy

46. In September 2021, a Short-Term Strategy 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.

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

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

48. These recommendations will be covered in a more detail below and the relevant investments are captured in our Asset Health submission with full details in their respective Engineering Justification Reports.

Maintain Site Safety and Integrity

49. Work is needed urgently to ensure the site is safe. Concerns have been 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.

50. 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.

51. Therefore, the recommendation is to:

    - Reduce the current risk to site staff by demolishing Units 2C and 2D due to safety concerns around the cladding containing asbestos. This is covered in the St Fergus Unit Decommissioning EJP.
    - Assure continued integrity and safety management of buried pipework by replacing the CP system. This is covered in the St Fergus Cathodic Protection EJP.
    - Initiate site wide painting to prevent further deterioration of above ground pipework. This will be covered in a future St Fergus Corrosion Remediation and Prevention EJP to be submitted in June 2023.

Maintain Terminal Operability

52. 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.

53. 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.

54. 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.

Maintain Compression Availability

55. There are currently three operational Avons on the site. After 2A ceases operation on 31 December 2023, there will 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.

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

57. Therefore, the recommendation is to:

    - Ensure there are four operational Avons by carrying out cab infrastructure work to reinstate Unit 2B. This is covered in the St Fergus Avon Operability and Availability EJP.
    - Facilitate ongoing security of supply by replacing the required elements of Plant 1 aftercoolers then assessing Plant 2 aftercoolers and resolving identified issues. This is covered in the St Fergus Plant 1 Aftercooler EJP.

Retain Flexibility of Options for the Future

58. Until the results of the Preliminary FEED were completed 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. 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.

59. However, to meet the Cyber reopener in January 2023, FEED work for the control systems began around April 2022 and a definitive view of which units will be retained was confirmed by August 2022. Therefore, it was proposed that plans for Cyber work proceed on the assumption that five units would be retained and the assumption would be reviewed and updated following the results of the Emissions UM Submission, ahead of reaching F2.

60. Therefore, it was recommended that we retain all five Avons until the result of the Emissions Preliminary Front End Engineering Design (FEED) was available to retain flexibility of options but avoid investment on Unit 1C. This meant including all five units in Cyber plans until the scope of work and options have been established, at which point the FEED results can refine which units are taken further.

Summary

61. Based upon the analysis carried out, the recommended strategy for each compression plant is summarised in Figure 10.

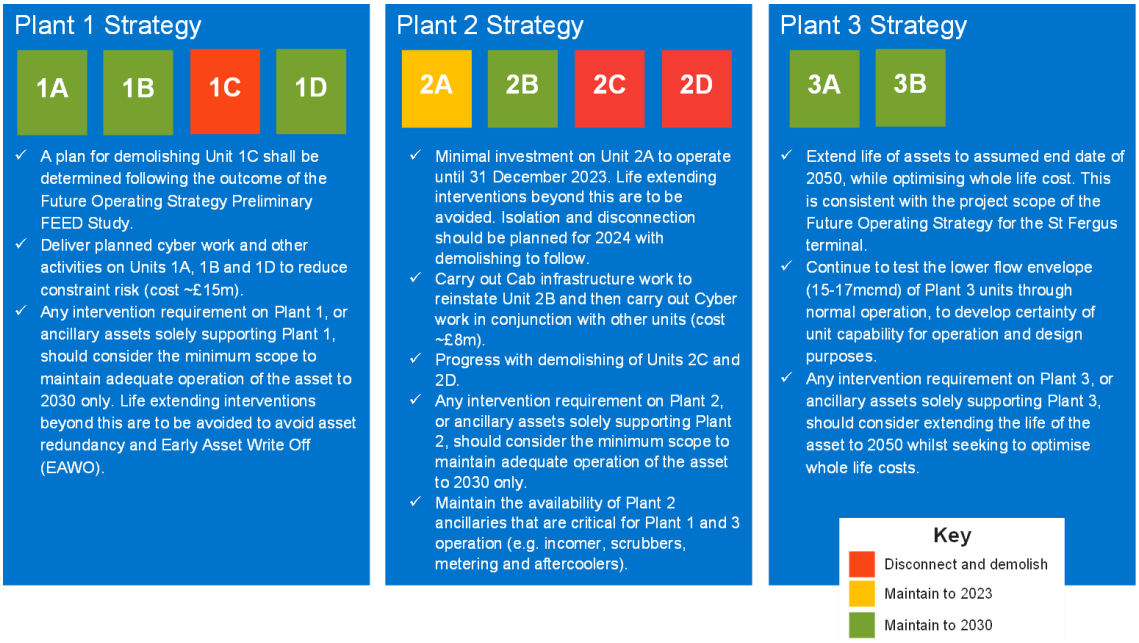

Figure 10 - Recommended Strategy by Unit

7. Long-Term Strategy

62. Following a detailed and in-depth 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.

63. The difference in capability across a sample of the options considered is shown in Figure 11. 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.

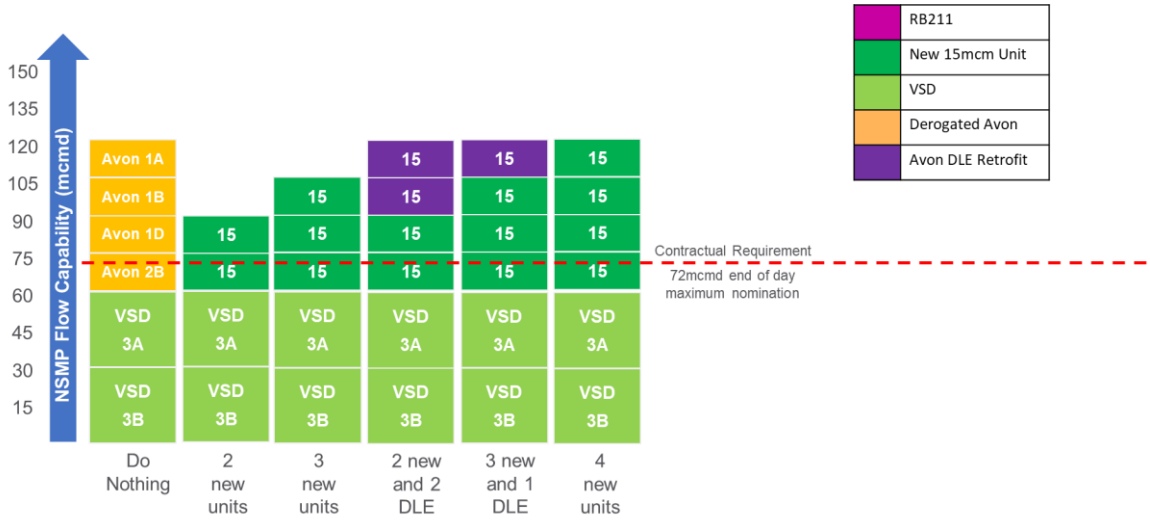

Figure 11 – Site capability under different potential long-term options

64. We have been working collaboratively with [redacted] to progress a prototype of Dry Low Emissions (DLE). 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. 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.
65. 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] (2018/19) +/-30%.
66. More information on this recommendation is available in our Emissions FOSR.

8. Interaction Between Investments

67. 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.

68. 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 3.

69. 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	An Asset Health investment will be submitted in June 2025 dealing with the replacement of LV switchboards. Some of these 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.
Emissions Compliance	Asbestos cab risk mitigation	There is a short-term requirement to address asbestos containing cladding on Units 1A, 1B, 1C and 1D. The current proposal to make these safe for continued operation to 2030 by repainting them or decommissioning if no longer required. Where units can be decommissioned this would most likely be done as part of the Emissions Compliance delivery and therefore that cost will not be included in the Asbestos Removal funding request.
Avon Operability and Availability	Asbestos cab risk mitigation	To address the asbestos on Units 1A, 1B, 1C and 1D a survey will be undertaken. However, a survey of Unit 1C has already been completed as part of the Avon Operability and Availability investment to help inform which Avon should be returned to operation. Therefore, that unit will not be included within the survey scope.
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 Units 2B which is planned to be returned to operation as part of the Avon Operability and Availability investment.

Interacting Investments		Notes
		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.
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.

Table 3 – St Fergus Investment Interactions

9. Conclusions

22. 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.

23. Through the St Fergus Emissions Uncertainty Mechanism submission, we are proposing 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).

24. 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 June 2023. This will then provide the basis for a baseline funding request in our RIIO-T3 submission.

25. Through the Asset Health UMs, we are proposing 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 Grid Gas Transmission (NGGT) will utilise the Asset Health Reopener Submission to request funding for these investments. A number of these investments could not wait for this submission and have commenced, or been completed, at risk. Therefore, these funding requests are retrospective.

10. 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	Replacement of unit and terminal control systems
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	The proposal is to replace 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	The proposal is to replace the CP system.
Avon Operability and Availability	Asset Health January 2023 Reopener	The proposal is for investment in 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	Plant 2 Aftercoolers are of the same age and in similar condition to Plant 1 Aftercoolers, therefore the proposal is to assess through intrusive condition assessments once Plant 1 is returned to service.
Asbestos Cab Risk Mitigation	Asset Health June 2023 Reopener	Asbestos risk mitigation for Avon cabs on Plant 1 (Units 1A, 1B, 1C and 1D).
Corrosion Remediation and Prevention	Asset Health June 2023 Reopener	Remediation of all identified high risk corrosion defects.
Tanks and bunds	Asset Health June 2023 Reopener	Repair or replacement of the tanks and the associated bunds
Structural integrity	Asset Health June 2023 Reopener	Repair or replacement of significant structures
Lighting	Asset Health June 2023 Reopener	Refurbishment and replacement of Lighting system on site for safe operation

Investment	Planned Funding Route	Specific Works Proposed
Site ducting	Asset Health June 2023 Reopener	Replacement/Refurbishment of site ducting.
Lube oil systems	Asset Health June 2023 Reopener	Refurbishment and replacement of Avon lube oil systems
Electrical system	Asset Health June 2023 Reopener	Replacement of electrical distribution assets to comply with current safety standards such as the EAWR and DSEAR
Distribution boards	Asset Health June 2023 Reopener	Replacement of plant's distribution boards in compliance to BS7671 requirements
Standby generators	Asset Health June 2023 Reopener	Replacement of standby generators which are passed their design life and face obsolescence
Vent system	Asset Health June 2023 Reopener	Replacement of vent system piping to ensure it is fit for purpose
Fire suppression	Asset Health June 2023 Reopener	Design, supply, installation, and commissioning of the fire suppression system
Fuel gas heating	Asset Health June 2023 Reopener	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 June 2023 Reopener	Replacement of the fire water system components to provide reliable firefighting capability until 2050.
VSD access roof panel	Asset Health June 2023 Reopener	Modification of the VSD compressor cab to enable access by removing existing clad panels and installing electrically driven roof panels
LV switchboards	Asset Health June 2023 Reopener	Reduce the risk on the network and re-life the equipment by removing known safety/environment and reliability issues on LV switchgear
Access road monitoring and replacement	Asset Health June 2023 Reopener	Refurbishment of the site's road infrastructure
Damaged and broken drainage asset replacement	Asset Health June 2023 Reopener	Replacement of drainage assets required to enable safe runoff of rainwater and sewage to appropriate locations all year round
HV transformer	Asset Health June 2023 Reopener	Replacement of six auxiliary transformers supplying the main terminal building plant 1 and 2 switchboard to meet present BS standards.
Valves	Asset Health June 2023 Reopener	Major maintenance, component replacement, vent and sealant line replacement, actuator repair or replacement and corrective actions to ensure valves on site can provide an effective seal against full line pressure once fully closed
HV switchgear	Asset Health June 2023 Reopener	Replacement of HV switchboards that have reached end of life and obsolete with new intelligent type switchboards

Table 4 – Breakdown of Asset Health Investments

11. Glossary

Glossary	
Avon	Rolls Royce (Siemens) gas turbine engine which forms part of the compressor machinery train and is subject to MCPD.
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.
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.
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**
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.
MCPD	**Medium Combustion Plant Directive:** A directive to reduce emissions from combustion plants with a net thermal input between 1-50 MW.
NGGT	**National Grid 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.
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.
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.