



**RIIO-T2 Asset Health Submission**

**Bacton Investment  
Strategy Summary  
January 2023**

**nationalgrid**

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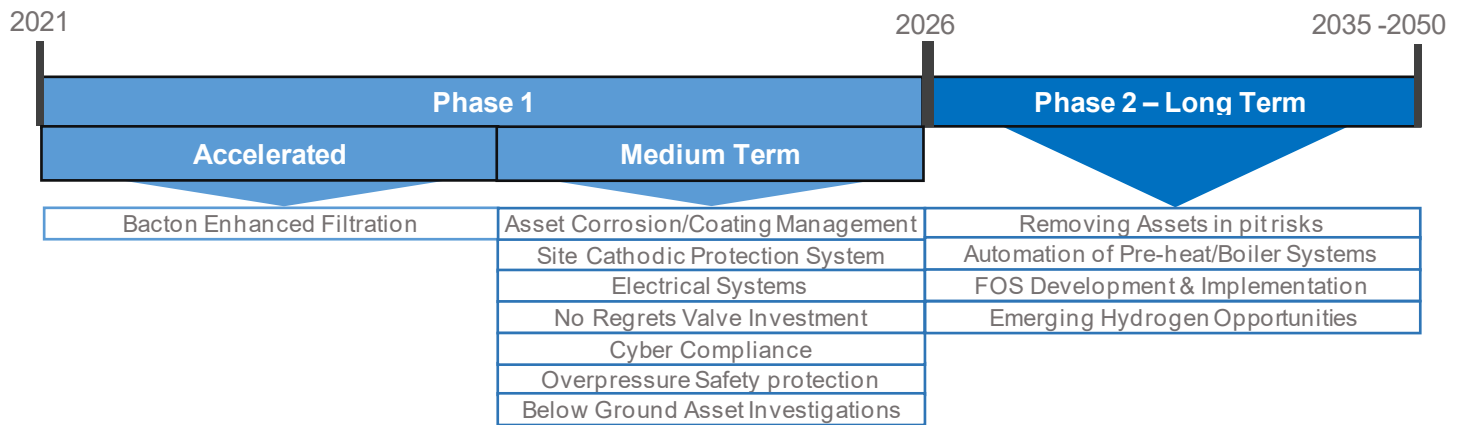
## 1. EXECUTIVE SUMMARY

- 1.1. Following on from the RIIO-T2 Final Determinations, the strategic direction for our investment proposals at Bacton has needed to change for several reasons. The original RIIO-T2 proposals for brownfield development have been shown now not to be viable due to a multitude of changing circumstances which include: -
  - Compliance with latest safety obligations on spacing and minimum separation distances of differing types of above ground plant and equipment, sources of release from adjacent plant; and the risk of an escalation event
  - The ongoing Russia/Ukraine crisis, and high sustained export flows into Europe (and the criticality of maintaining such continental supplies)
  - A significantly increased risk related to liquid and dust entering the facility (due to such continued high export flows)
  - Increased interest and proposals related to new Hydrogen developments in the area.
- 1.2. It must be recognised that Bacton is one of the most strategically important sites on the NTS. It delivers significant volumes of gas in and out of the country, connects the UK to EU markets, has Upper-Tier COMAH classification and delivers gas to local Distribution and Power-station customers, to five National Transmission System (NTS) feeders that supply a vast area of the southeast including London.
- 1.3. It is imperative that we safely manage this site in the short, medium and long term and our revised investment strategy seeks to achieve this by adopting a two-phase strategy to ensure clarity between Phase 1 No Regrets Asset Health investments and Phase 2 long-term site operating strategies.
- 1.4. Our Bacton Phase 1 (Short (Accelerated) & Medium Term) strategy ensures we have certainty on the Terminal operation requirements for operation out to 2035 and includes the investments required to facilitate this. It will provide certainty of investments as no-regrets based on the current options developed through the Front-End Engineering Design (FEED).
- 1.5. We have split our Phase 1 short-medium Term Strategy into two categories.
  - Accelerated investments have been categorised due to the current impact the needs case is posing to Terminal operations. Doing nothing is not an option and investments have commenced at risk. Funding for these investments will be requested through the January 2023 and June 2023 Asset Health Uncertainty Mechanism (UM) windows.
  - Medium Term investments have been identified as no regrets based on the options under consideration through the FOS workstream. Funding for these investments is proposed to be requested through the June-23 and Jan-24 Asset Health UM windows, plus the Cyber OT year 3 reopener.

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- 1.6. The Phase 2 long-term strategy will deliver the enduring Terminal solution required for operation beyond 2035, including net zero futures, as part of the Bacton Terminal Site Redevelopment Reopener and Price Control Deliverable, for which a Final Option Selection Report shall be submitted in February 2024.
- 1.7. Based upon this strategy, for Phase 1 Investments, are a series of Engineering Justification Papers (EJPs) which will be submitted to Ofgem through various RIO-T2 reopeners. These EJPs will cover the investments listed in Figure 1.

Figure 1: Alignment of investments to strategies



- 1.8. A summary of each investment is provided here but full detail and justification is captured in the individual EJPs.
- 1.9. Accelerated Investment has commenced on two projects: -
  - To provide short-term ‘best-endeavours’ mitigation from dust entering the Terminal. Investment to install additional filters into the spaces available within the existing incomer filter banks has commenced with two new and one repurposed additional filter being fitted. This has commenced at risk. Significant investment has also proceeded to install liquid monitoring systems in our main incomer lines.
  - To implement enhanced safety requirements into our existing incomer pressure protection systems to comply with wider legislation / best-practice requirements and address ongoing Health and Safety Executive concerns and enforcement actions.
- 1.10. Additionally, in respect to the ongoing risks from dust entering the Terminal; optioneering has been conducted and a preferred option identified to mitigate dust ingress from the NTS. An EJP shall be submitted in the January Asset Health Reopener submission window.

## 2. BACTON INVESTMENT STRATEGY INTRODUCTION

- 2.1. Through the RIIO-T2 submission National Grid Gas Transmission, thereafter, called NGGT developed a proposal to redevelop Bacton Terminal utilising land within the existing Terminal footprint. As part of additional Front End Engineering Design (FEED) during RIIO-T2 it was determined that the RIIO-T2 proposals for brownfield development was now not to be viable, due to the outcome of a FPSA (Formal Process Safety Assessments) study.
- 2.2. Further options are currently in development within this FEED study with a Final Option Selection Report to be submitted to Ofgem in February 2024.
- 2.3. Whilst the FEED study has been in development a full reassessment of the need across the short, medium and long term has been carried out. A number of short to medium term investments have been identified that were either part of the long-term site solution or are new investments that have been identified through the additional FEED activities. Investments within these categories that are no-regrets have been identified.
- 2.4. NGGT is proposing to submit a number of Engineering Justification Papers utilising the Asset Health Reopener submission windows to request funding for these no regrets investments.
- 2.5. This document provides a summary of the revised investment strategy and the investments being developed. The investment strategy was approved by the Gas Transmission Investment Committee in September 2022.

## 3. SITE OVERVIEW

- 3.1. Bacton Terminal is located on the east coast of the UK. Bacton is one of the UK's nine gas Terminals connected to the NTS, located 20 miles from Great Yarmouth. It is a site of strategic importance, capable of supplying up to a third of the UK gas demand on a winter day, whilst also able to export to the continent via the two interconnectors. The plant was built and commissioned in 1968 and operates 24 hours a days 365 days a year, regularly supplying in the range of 10% to 20% of the UK's natural gas supplies.
- 3.2. The Terminal connects two sub-Terminals (Currently owned by Shell and Perenco) and two interconnectors (Interconnector UK and BBL) to the UK National Transmission System (NTS). Gas enters the Terminal at a maximum pressure of 83 Bar (Safe Operating Limit (SOL)) and within the Terminal has a SOL of 77 bar.
- 3.3. NTS feeders 2, 3, 4, 5 & 27 connect into the Terminal and can be used for import/export for BBL & Interconnector UK or export from the sub-Terminals connected to the site.

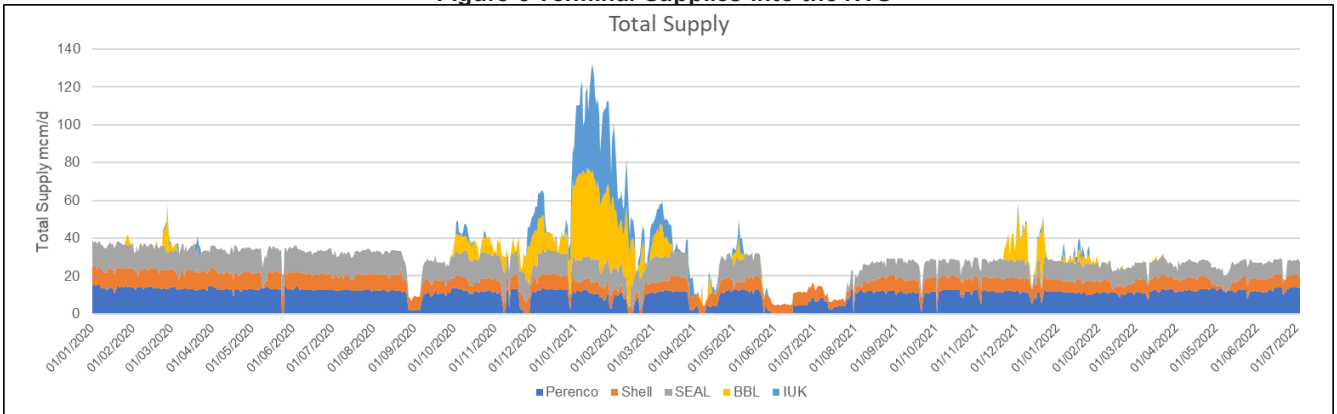
# RIIO-T2 Bacton Investment Strategy Summary

**Figure 2 Bacton Terminal Location**

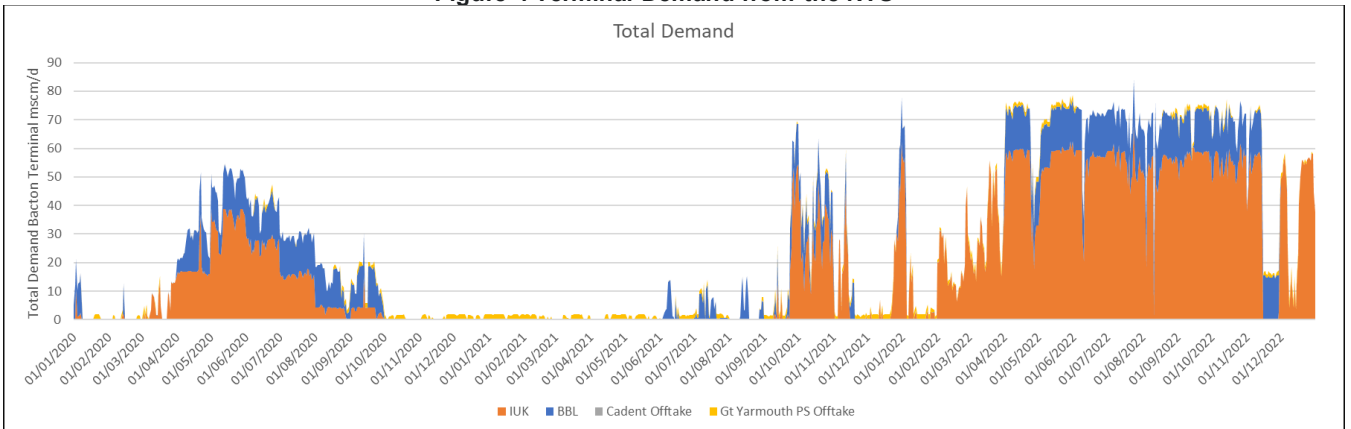


3.4. United Kingdom Continental Shelf (UKCS) supplies into the Terminal provide a base level of supply throughout the year, with Interconnector supplies and demands being reflective of market conditions both in the United Kingdom and Mainland Europe. The graphs below, shown in Figure 3 & Figure 4, evidence the variations in supply and demand patterns at the site.

**Figure 3 Terminal Supplies into the NTS**

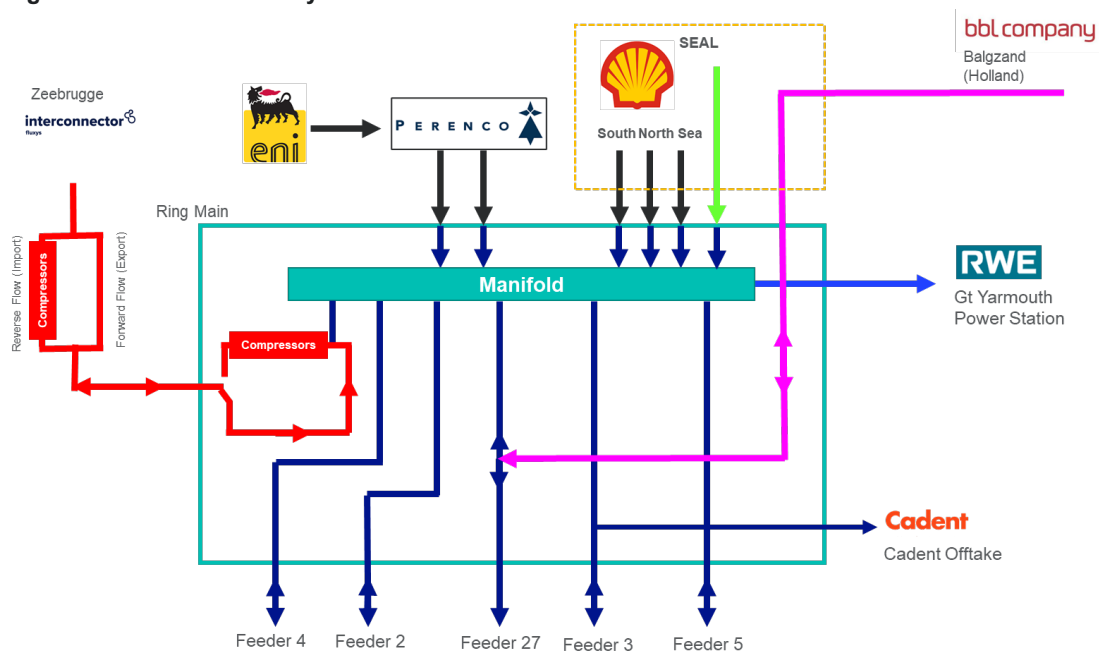


**Figure 4 Terminal Demand from the NTS**



- 3.5. A significant change to the utilisation of the site has been seen during calendar year 2022. An increase in Interconnector exports from the site have occurred due to the geopolitical situation in Europe and the impact this has had on the gas market supply and demand fundamentals.
- 3.6. The figure below provides a summary of the Terminal configuration and the connected customers. There are two UKCS offshore connections at the Terminal, Perenco (production commenced 1968) and Shell (production commenced 1999). Gas is also produced by ENI but is transported into Perenco’s terminal to process before entering the National Grid Terminal. These provide a base level of supply, and each operator is governed by its own Network Entry Agreement (NEA).

Figure 5 Terminal Summary



- 3.7. Two Interconnectors connect into the Terminal. Interconnector UK has compressors located at the site to assist with operations. These interconnectors can import and export to and from the Bacton Terminal. In addition, we have two other demand customers, RWE Great Yarmouth power station and Cadent Bacton GDN offtake.

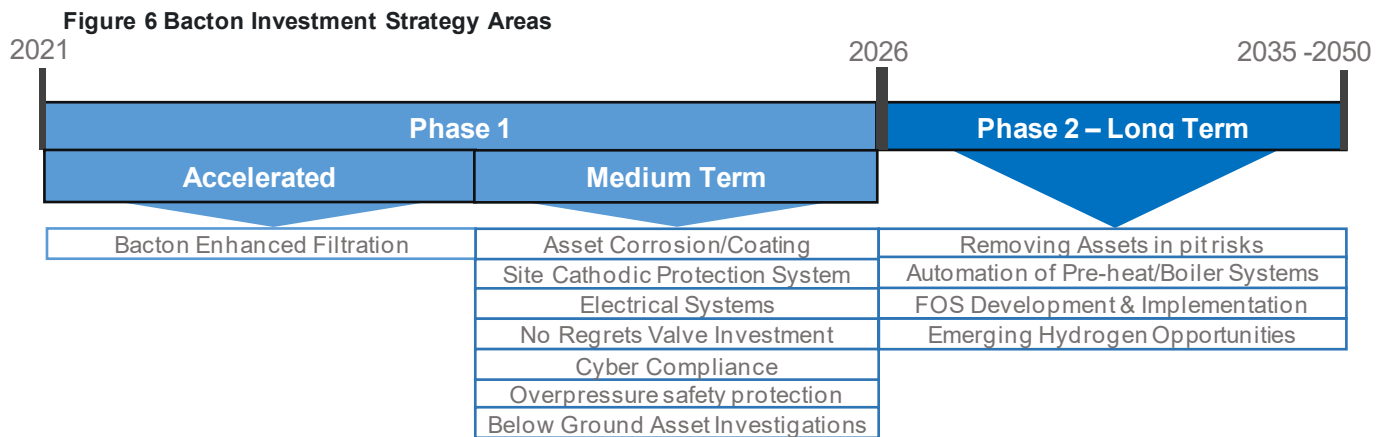
#### 4. INVESTMENT STRATEGY

- 4.1. Our Bacton Investment Strategy seeks to optimise the management of our assets out to 2050.
- 4.2. Our RIIO-T2 investment plans were developed in themes and broadly can be split between no regrets Asset Health, Decommissioning and Physical Security investments and funding to develop Future Operating Strategy (FOS) options. Asset health, Decommissioning & Physical Security investments have received baseline funding, are currently in different stages of delivery on site and therefore whilst linked to our strategy are not directly impacted.
- 4.3. Our Bacton investment strategy has been split into two Phases (Phase 1 & Phase 2). Our Phase 1 Strategy shall look to manage asset risks across the Terminal whilst the clarity on the

## RIIO-T2 Bacton Investment Strategy Summary

future Terminal solution is developed through the Future Operating Strategy FEED. Investment shall be no regrets against the options currently in consideration through the FOS.

- 4.4. Our Phase 2 Long Term strategy investments shall be delivered through or in parallel to the FOS, delivering long term value and managing asset integrity. This strategy shall iterate through emerging clarity on FEED optioneering but will support the utilisation of Bacton as a strategic entry/exit point on the network now and into the future.
- 4.5. Figure 6 provides a summary of our Strategy.



- 4.6. All investment proposed in Phase 1 of our strategy relate to where we do not have baseline funding within our RIIO-T2 Business Plan. Where Asset Health Uncertainty Mechanisms are available, we propose that these will be utilised in accordance with the RIIO-T2 final determination and license conditions.  
In addition, the Cyber OT Year 3 reopener is proposed to be utilised to request funding for the Cyber OT elements for the Phase 1 Medium term Strategy.
- 4.7. Accelerated investments, within Phase 1, have been categorised to reflect the materiality of the impact from a no investment position. Funding for these investments will be requested through the January 23 and June 23 Asset Health UM windows.
- 4.8. Medium Term investments have been identified as no regrets based on the options under consideration through the FOS workstream. Funding for these investments will be requested through the June 23 and January 24 Asset Health UM windows and Cyber OT year 3 reopener.
- 4.9. Early discussion with Ofgem on our Strategy has commenced, including the emerging scopes and options to fund all the works that are efficient and no regrets against all potential options available through the Future Operating Strategy (FOS) workstream.



## PHASE 1 – ACCELERATED

### Filtration Enhancement – Part 1

- 4.10. Filtration is currently installed on the incomers at the site to ensure gas entering the site is in line with GS(M)R specification. Solids and Liquids are produced during the offshore production process and filtered both by the upstream provider and by us upon entering National Grid Terminal. Within our Terminal several filters are installed on each incoming stream that are designed to filter solids and dust particles above two-micron particle levels. We have no equipment assets (such as coalescers) to collect and mitigate liquid excursions or any installed filtration on our feeders (Feeder 2, 3, 4, 5 & 27) to filter gas coming into the Terminal from the NTS.
- 4.11. Recent network operating conditions driven by the Russia Ukraine conflict has resulted in significant exports from the UK to Europe through Bacton Terminal with Feeders 2, 4 and 27 used for bulk transmission to Bacon Terminal. With there being a high and sustained West – East flows of gas, there is a greater likelihood of internal pipe-work debris ending up at Bacton from across the whole network. A number of issues have occurred resulting in disruption to European exports due to the build-up of material within our filters and our customers filters.
- 4.12. Investigations across the network have not identified any significant collection of material, investigations have focussed on the understanding any build-up of materials at filters on other sites, including King's Lynn Compressor & West Winch offtake on Feeder 2. Nothing has as of yet been identified. Additional In-line Inspections have been completed with [REDACTED] of solids removed from Feeder 4 from the November 2022 inspection.
- 4.13. To mitigate the impacts of dust and liquid we have adopted an enhanced 'best endeavours' Terminal operating strategy to provide additional filtration by recirculating the incoming NTS gas from Feeders 2 & 4 back through the Terminal Ring Main into spare existing incomer streams & associated filtration equipment. This enables up to [REDACTED] to be double filtered at the site.
- 4.14. However, this enhanced filtration operating strategy is not how the Terminal was originally designed to operate and is highly dependent both on stable Inter-Terminal operations (both NGGT and wider upstream process operating conditions at Shell / Perenco) and equipment availability / reliability; with a myriad of differing possible combinations of process upsets / plant availability issues preventing such double filtering from being achievable, hence the ongoing present risk currently lying with NGGT.
- 4.15. Such current conditions also place a high and sustained operating, as well as health, safety and environmental burden on ongoing Terminal operations. The incomer filtration equipment used to double-filter currently requires filter changes approximately every two months. Such operations result in the venting of large quantities of natural gas as individual filter streams alone cannot be safely isolated, leading to larger plant isolations. Additionally, site personnel involved in such operational and maintenance activities have increased health risks associated with more prolonged exposure to specific breaking containment hazards including but not

## RIIO-T2 Bacton Investment Strategy Summary

limited to potential exposure to pyrophoric dust, naturally occurring radioactive material (NORM), and benzene, toluene & xylenes (BTEX).

### Recommendation

- 4.16. It is recommended that investment commences to enhance the incomer filtration, installing additional filters into the spaces available within the existing incomer filter banks. In the interim this provides the maximum amount of resilience to filter solids (dust) from the gas flow. This has commenced spend at risk.
- 4.17. It is also recommended that additional filtration be installed at the Terminal to filter gas from our feeder connections at the site. Installation of feeder filtration will ensure Bacton Terminal can manage both high export flows while reducing the risk to upstream UKCS Terminal supplies by eliminating the need to double filter gas via the ring main. This should also provide a resilience to security of supply, reduce the amount of filter maintenance activities, reduce outages and gas inventory venting.
- 4.18. The proposals within our Bacton Filtration Engineering Justification Paper (EJP) includes:
- Installation of additional filters on the incomer filter banks and the procurement of spare filter cartridges.
  - Installation of new filter banks on two feeders (Feeder 2 & 4) connecting into the Terminal.
- 4.19. We propose to install filtration on Feeders 2 & 4 as these are used along with Feeder 27 for bulk transmission of gas from the NTS into Bacton Terminal for Interconnector exports. No dust or debris material has been identified within Feeder 27 and no issues raised from the customer who preferentially (due to closeness of connection to Feeder 27) receives most of the gas transported through this feeder, so this option has presently been discounted in our assessment.
- 4.20. For further detail on the need case and optioneering, please read our Bacton Filtration EJP.

### **Filtration Enhancement – Part 2**

- 4.21. In addition to the investments proposed as part of Filter Enhancement Part 1, we are also reviewing a range of other enhancements to our filtration at the site. This includes review the level of liquid mitigation at the site and reviewing the ability to increase the flexibility of operating and maintaining our existing filter banks.
- 4.22. These enhancements include solutions that enable isolation of individual filters within the filter bank (potentially involving the installation of new valves or changing the existing valves) and fitting mobile recompression points to reduce the amount of gas inventory purged to atmosphere.

## RIIO-T2 Bacton Investment Strategy Summary

4.23. These investments are at an early stage of development and are being reviewed in collaboration with other UM workstreams, i.e. Methane Emissions Reduction Collection reopener. It is proposed that any investment proposal shall be submitted utilising the June 2023 AH Reopener submission window.

### PHASE 1 - MEDIUM TERM

4.24. Additional investment areas identified within the medium-term section are currently being explored and developed. The investment strategy shall be updated when these scopes have progressed and matured.

#### **Asset Corrosion/Coating Management**

4.25. Above ground corrosion is a known issue at Bacton due to its coastal location and the primary deterioration and failure mode for asset corrosion and re-active expensive cut-out and replacement activities.

4.26. To reduce exposure to such activities and costs, and to begin the proactive asset management regime of above ground pipework assets, it is recommended that the Terminal moves to a phased pro-active paint-coating regime at the earliest opportunity and the need for such combined within other planned RIIO-T2 works to deliver future efficiency savings, and reduced consumer costs from current reactive programmes of work.

4.27. Baseline funding was awarded as part of the Plant & Equipment investment theme for years 1-3 of RIIO-T2. We are developing our strategy and associated investment plans for years 4 & 5 and propose to utilise the Asset Health Uncertainty Mechanism windows to seek funding.

#### **Cathodic Protection**

4.28. The Bacton Terminal site has circa 5km of buried pipework which is protected from corrosion through external coating systems and an applied Cathodic Protection (CP) system. The system has been operational since the Terminal commissioning.

4.29. There are a range of defects on the current CP system ( [REDACTED] ) and initial investigations have identified a range of improvements are required to the system. Options within the Future Operating Strategy FEED (Asset Health & New Terminal Options) necessitate the retention of several below ground assets within the existing site requiring an operational CP system.

4.30. Electrical Resistance (ER) probes have been installed to collect data on the performance of our CP system and the condition of our below ground pipework data. Data is expected in early 2023 and shall inform the investment proposed on our CP system. [REDACTED]  
[REDACTED]



4.31. Baseline funding was awarded as part of the Plant & Equipment investment theme for the first three years of RIIO-T2, for CP Investigation and Rectification [REDACTED] however based on these results we believe intervention in excess of this funding is required and a further funding request will be submitted through the Asset Health Reopener windows.

### **Electrical**

4.32. A number of electrical systems at the site are the original systems installed when the site was commissioned in 1968. They have been operating well in excess of their design life. The existing generator is oversized, however has a range of functionality issues. A portable standby generator is currently installed due to this.

4.33. There are several defects on the Uninterruptable Power Supplies (UPS) system, which itself is operating beyond its design life. There is also a single cable and distribution board that supplies the UPS, therefore a single point of failure. A range of investments were explored on the electrical systems at the site in RIIO-T1 but deferred due to the FOS option uncertainty.

4.34. We are exploring whether we need to accelerate any investments in the Electrical systems, utilising asset health reopener windows, or whether to include any investment as part of our FOS submission.

### **Overpressure Safety Protection**

4.35. The incomer pipelines from Shell and Perenco are protected against over-pressurisation by motorised valves which operate should the pressure exceed 74-75 barg (apart from Shell Incomer S4 which is set to 83 barg).

4.36. Shell Incomers S1, S2 and S3 have a Safety Integrity Level (SIL) of SILa; S4 and Perenco incomers, A1 & A2, have a SIL rating of SIL1. All these systems are regularly safety tested. A High-Integrity Pressure Protection System (HIPPS) is installed at the Interconnector Terminal to protect pipework from excessive overpressures, caused during different modes of operations. During reverse flow, the pipework downstream of the compressors, which includes the metering package and National Grid system, is protected by a Category 1 HIPP system.

4.37. A detailed assessment of the overpressure protection on Perenco A1 and A2 Incomers and the Shell SEAL (S4) incomer has concluded that the risk associated with overpressure is considered intolerable without further mitigation, therefore this project seeks to provide sufficient risk reduction and demonstrate the risk is ALARP.

4.38. The Health and Safety Executive (HSE) have issued an Action Legal notice and the work must be carried out as soon as possible, thus has commenced spend at risk.

4.39. The objective of the investment is to mitigate the risk of overpressure to Bacton Terminal to an acceptable level of risk. National Grid have undertaken several studies to review the current overprotection arrangements. The purpose of these works is to undertake the recommendations made in the overprotection studies and mitigate the risk to the Terminal to an acceptable level.

Recommendation

4.40. Given the timeframes associated with the HSE Action Legal Notice, the project has progressed at risk and retrospective funding shall be requested through the Asset Health Reopener windows.

[Redacted]

[Redacted]

[Redacted]

[Redacted]

## PHASE 2 – LONG TERM

- 4.44. Phase 2 of the Investment Strategy has a range of strategic outcomes and shall be iterated through and in parallel to the Future Operating Strategy (FOS) development.
- 4.45. These include:
1. Managing longer term asset and operational risk at the site
  2. Supporting the development of the FOS, through a holistic understanding of Terminal risks.
- 4.46. Our Phase 2 Long Term strategy shall iterate through the FOS development, with investments developed through or in parallel to it.
- 4.47. This element of the strategy shall iterate through the emerging clarity of options as FEED optioneering progresses but should support the utilisation of Bacton as a strategic entry/exit point on the network now and into the future.
- 4.48. There are a range of long-term Hydrogen opportunities at the site. Phase 2 shall be cognisant of these opportunities and support the transition should they materialise at site.

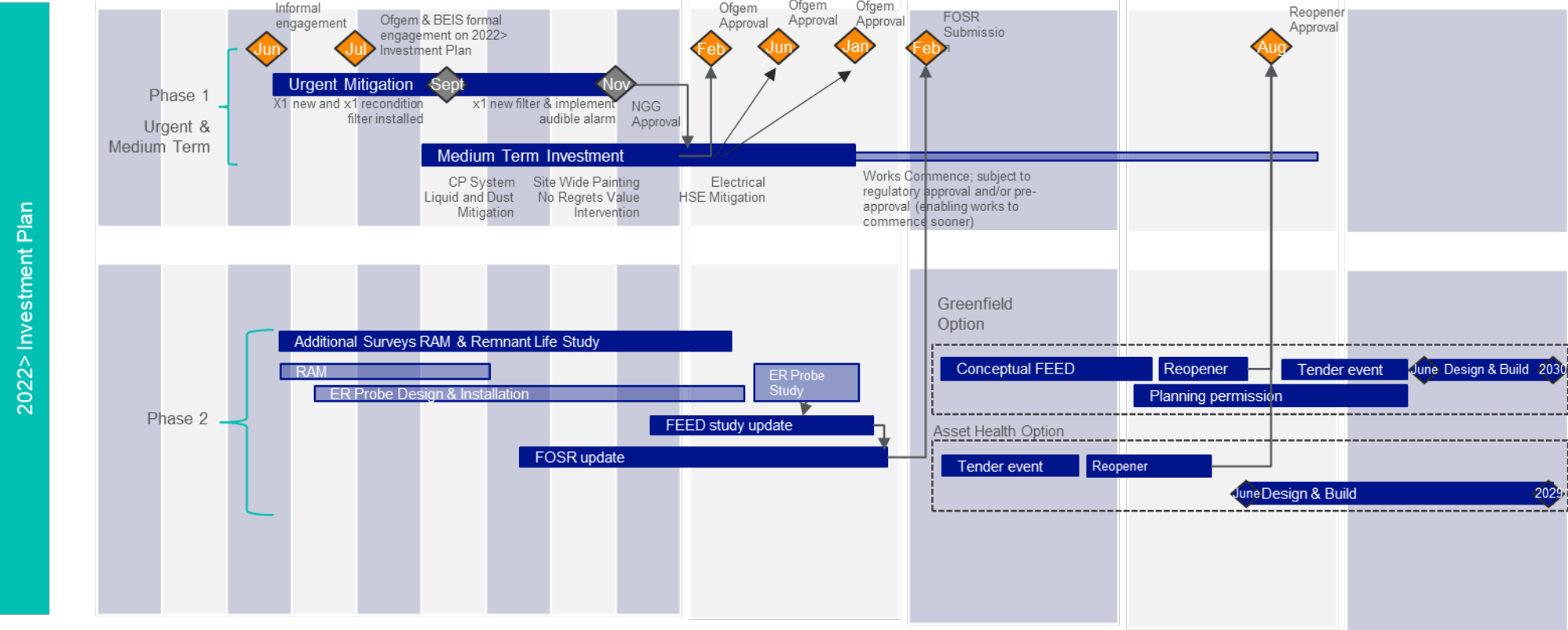
## 5. RETAIN FLEXIBILITY OF OPTIONS FOR THE FUTURE

- 5.1. During RIIO-T2, we will conclude a significant FEED study to determine the best way to meet our site requirements until 2050 (Our Future Operating Strategy), whilst maintaining the remaining plant through a combination of our Asset Health budgets.
- 5.2. The feasibility study shall include all necessary surveys (including remnant life of pipework), assessments, risk identification, cost estimates (+/-30%), programme and design development to enable a submission to Ofgem under the RIIO-T2 Uncertainty Mechanism. Following a successful reopener submission, we will progress the selected option into conceptual design where we will progress the design work to a sufficient level to inform the costs to an accuracy of +/-15%. This will inform the second reopener in 2026. We will then begin detailed design and build works for the future state of the Terminal.
- 5.3. The Preliminary FEED results are anticipated in Q3 2023. Until this point, we cannot be certain on the preferred option for the future operation of the Terminal (ongoing asset health or redevelopment of the Terminal).
- 5.4. However, in order to manage Short-Medium term asset health challenges additional investments to those included in our RIIO-T2 business plan are being progressed where these have been deemed 'No Regrets'. Funding shall be requested as part of our Asset Health reopener submissions.

## 6. RECOMMENDATION AND TIMELINE

- 6.1. Based upon the development to date the development timelines are shown on the plan on the following page. This reflects both Phase 1 and Phase 2 of our investment strategy.
- 6.2. As investments are in the early stages of development, timelines are subject to change. Our Investment Strategy shall enable us to pivot upon the receipt of fresh information to ensure we are optimising our investment plans and ensuring value for money for consumers.

Figure 7: Recommended Strategy





## 7. RIIO-T2 INVESTMENT THEMES OVERVIEW

### BACTON FUTURE OPERATING STRATEGY

- 7.1. This investment has [REDACTED] of baseline funding for FEED. It is a Price Control Deliverable, subject to true-up. The remainder of any funding will be subject to an Uncertainty Mechanism.
- 7.2. This Uncertainty Mechanism will have two touchpoints within Gas Network Development Process (GNDP), at the end of Stage 4.2 (February 2024) ahead of Conceptual FEED or Tender events and at the end of Stage 4.3 (August 2025). This will select the preferred Terminal redevelopment option and release funding to implement the solution.

### ASSET HEALTH

- 7.3. Baseline funding has been awarded in the RIIO-T2 business plan for least regrets investments at the site. These included investments within the following Asset Health themes; Cabs – Fire Suppression Systems, Plant & Equipment, Structural Integrity (Civils), Security and Fencing, Access and Buildings
- 7.4. There is an Uncertainty Mechanism for Asset Health (Cabs, Plant and Equipment) with submission windows in January 2023, June 2023 & January 2024. This is expected to release further funding for these themes in RIIO-T2 in line with accelerated and medium-term investment areas within Phase 1 of our strategy.

### REDUNDANT ASSETS

- 7.5. Baseline funding was awarded in the RIIO-T2 business plan to demolish a number of redundant assets that had been identified at the Terminal.
- 7.6. The scope of works included:
- Decommissioning of ENI incomer assets following the disconnection of this customer during RIIO-T1
  - Decommissioning of redundant methanol tanks and odourisation equipment.
  - Decommissioning of several preheating boiler packages no longer required

### PHYSICAL SECURITY

- 7.7. Baseline funding was awarded in the RIIO-T2 business plan to undertake asset health investments on the Enhanced Physical Security solution, installed during TPCR4.
- 7.8. The scope of works included:

[REDACTED]



## 8. APPENDIX 1 – APPROVAL

The Bacton Investment Strategy was approved by the National Grid Gas Governance group on 12<sup>th</sup> September 2022.