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RIIO-T1 reopener consultation: One-off Asset Health Costs (Feeder 9)

Consultation

Publication date: 8 August 2018

Response deadline: 29 August 2018

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Overview

The RIIO-T1 price control includes two reopener windows for companies or Ofgem to propose adjustments to expenditure allowances for certain categories of costs that were deemed to be too uncertain to provide ex ante allowances at the time of our Final Proposals.

This document sets out our initial views on National Grid Gas Transmission's application under the "One-off Asset Health Costs" category of uncertain costs, to cover the costs of a replacement for the Feeder 9 pipeline under the Humber estuary.

We welcome the views of interested parties on the issues set out in this document. Responses should be addressed to gasnetworks@ofgem.gov.uk no later than 29 August 2018. Unless clearly marked as confidential, responses will be published on our website. We will consider the responses received before we make our final determination, which we will publish by the end of September 2018.

Context

RIIO-T1 and GD1 were the first price controls to reflect the new RIIO (Revenue = Incentives + Innovation + Outputs) model. The RIIO-T1 price control sets the outputs that the electricity and gas transmission network companies need to deliver for consumers and the associated revenues they are allowed to collect for the eight-year period from 1 April 2013 until 31 March 2021.

For cost categories where there was significant uncertainty about expenditure requirements at the time of setting allowances, the price controls include a "reopener" mechanism. This mechanism allows network companies to propose adjustments to baseline expenditure allowances for these cost categories when there is more certainty. The reopener mechanism has two windows during which adjustments to allowances may be proposed – one in May 2015 and the other in May 2018.

The cost categories subject to the reopener are:

- Enhanced Physical Site Security Costs;
- Industrial Emissions Costs;
- Pipeline Diversion Costs;
- Quarry and Loss Development Claim Costs;
- One-off Asset Health Costs; and
- Network Flexibility Costs.

The reopener process fits into priorities 3 and 4 of the 2018-2019 Ofgem Corporate Strategy.

We are required to make a determination by 30 September 2018 on any application received through the reopener mechanism.

Associated documents

The Gas Transporter Licence, Special Conditions, for National Grid Gas PLC (NTS)

Informal consultation on RIIO-1 price control reopeners (May 2018)

RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas

RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas: Cost assessment and uncertainty Supporting Document

RIIO-T1: Initial Proposals for National Grid Electricity Transmission and National Grid Gas

The RIIO-GT1 Price Control Financial Model

GT1 Price Control Financial Handbook – Version 2.0

Contents

Executive Summary

Feeder 9 is a high-pressure gas transmission pipeline operated by National Grid Gas Transmission (NGGT). NGGT has submitted an application for additional allowances of £139.9m[1] through the May 2018 RIIO-T1 reopener process to cover the cost of replacing this pipeline with a new pipeline that would pass through a tunnel under the Humber estuary.

Following our assessment, our initial view is that NGGT has not demonstrated that replacing the pipeline would be in the best interests of consumers. NGGT has identified a number of risks (including safety risk) with the current pipeline, and has developed a cost-benefit analysis (CBA) model to support its case for replacement. We have identified a number of concerns with NGGT's analysis and its assumptions. Our own analysis, using what we believe to be a more reasonable range of assumptions, indicates that replacement is not the most efficient solution for consumers.

We asked the Health and Safety Executive (HSE) to review NGGT's submission so that we could understand the strength of the safety case for replacement. The HSE's report (published alongside this document) considers that continued operation of the pipeline (supported by an inspection, mitigation and isolation regime) would be satisfactory. Moreover, the HSE carried out its own analysis (based on information provided by NGGT) and concluded that building a new tunnel to further reduce the risks would not typically be required by the HSE, if the risks are already shown to be as low as reasonably practicable (ALARP) and the net cost of reducing the risk by building a tunnel is higher than £5m (taking account of all costs to consumers and NGGT).

NGGT decided in April 2016 to proceed with tunnel construction, and has committed significant sums of money (£93m by the time of its application) to the project. We have looked at NGGT's decision-making process and the analysis carried out to support that decision. Our initial view is that NGGT's decision in 2016 to proceed with tunnel construction does not appear to have been supported by robust analysis. NGGT did not carry out a full assessment of all feasible options (including a CBA) before making its investment decision in April 2016, and seems to have discarded a key alternative to replacement (i.e. continued operation of the existing pipeline) for reasons that do not appear to us to be robust.

We recognise there are a number of risks associated with continued operation of the pipeline. However, based on our review and analysis of the evidence received to date, we do not think the case for replacing the pipeline has been demonstrated. Our

[1] All costs in this document are in 2009/10 prices unless otherwise stated

initial view is that we should reject NGGT's funding application for costs associated with the tunnelled replacement of Feeder 9.

We could consider allowing mitigation costs during RIIO-T1, however these costs (which we assess to be £6.4m) fall below the materiality threshold for this reopener (£28m) and therefore do not qualify. We may consider providing funding in RIIO-T2 for the efficient costs of mitigation of Feeder 9 incurred in the RIIO-T1 period, to the extent that funding has not already been provided in RIIO-T1.

If we reject NGGT's funding request, we also need to consider whether any of its actual expenditure on the tunnel in RIIO-T1 is demonstrably inefficient and wasteful. Whilst our initial view is that NGGT has not demonstrated the case for the pipeline replacement, we have not yet formed a view on how to treat costs incurred on the tunnel project. In particular, whether they should be shared with consumers through the Totex Incentive Mechanism (TIM) or disallowed from this mechanism and not be shared with consumers. We intend to make our position on this issue clear in our decision document in September.

Shortly before this document was due to be published, we received additional information from NGGT, in particular on the operational impact on the GB gas market of the loss of Feeder 9 due to emergency isolation. The timing of this information meant that we were not able to take account of it in reaching our initial views. However, we have included a summary later in the document of the information received from NGGT, and welcome stakeholders' views on it. We will take account of this information and any stakeholders' views on it when reaching our final decision.

We welcome views from stakeholders on all aspects of this consultation.

Next steps

This consultation will close on 29 August 2018. Please send in your response by emailing us at gasnetworks@ofgem.gov.uk.

In proceeding with a 21-day consultation we welcome engagement from interested stakeholders during the consultation period. The shorter period is driven by the licence requirement to determine any relevant adjustments to NGGT's allowed expenditure by the end of September and the time we need to consider responses to consultation, engage with interested stakeholders and revise our analysis, if necessary.

Our decision will be implemented through the 2018 Annual Iteration Process, which means that any adjustment to NGGT's allowed revenues would take effect from 2019/20.

1. Background

Chapter Summary
This chapter provides some information on the Feeder 9 pipeline, the project proposed by NGGT (a tunnelled pipeline) and the regulatory history of the project.

Context

1.1. Feeder 9 is a high-pressure gas transmission pipeline owned and operated by National Grid Gas Transmission (NGGT). It was constructed in 1984 and runs from the Easington Terminal on the East coast of England, towards Hatton Compressor Station in Lincolnshire and onwards to the South West. The Easington terminal connects Norwegian gas from the North Sea and is the UK's primary route for Norwegian gas imports. The terminal currently provides approximately 20% of the UK's gas supply[2].

1.2. Feeder 9 crosses the Humber estuary near the port of Hull through a shallow trench on the river bed. The underwater section of the pipeline is approximately three kilometres long, of which approximately one kilometre is under a busy shipping channel.

1.3. Underwater surveys conducted by NGGT in 2009 showed that river bed erosion in the vicinity of Feeder 9 had led to sections of the Feeder 9 pipeline being exposed, leaving it susceptible to the risk of damage from "free spanning"[3] and third party interference (e.g. anchor drop/drag or shipwreck).

1.4. In 2010, NGGT began 'mattressing' as part of its remediation approach to protect the Feeder 9 pipeline against further erosion and to encourage sediment formation over the pipeline. NGGT placed approximately 760m of concrete frond mattresses and 300 tonnes of gravel bags on top and alongside Feeder 9. Further mattressing work was undertaken in 2013 on a small section of the pipeline (50m). Recent river bed surveys indicate that, since the remedial works were undertaken in 2010 and 2013, no areas of pipeline exposure or free spanning have been observed, and there are no areas requiring immediate attention.

1.5. NGGT has said that the mattressing is temporary and only likely to last for 5 – 10 years. NGGT believes that a more efficient long-term solution is to build a replacement pipeline through a tunnel under the River Humber.

[2] pg 6, NGGT River Humber Gas Pipeline Replacement Project (Feeder 9) reopener submission
[3] A free span on a pipeline is where the seabed sediments have been eroded, or scoured away, and the pipeline is no longer supported on the sea or river bed.

Regulatory history of Feeder 9

1.6. This section provides a brief overview of the recent regulatory and price control history of Feeder 9.

The TPCR4 rollover price control (2012/13)

1.7. The TPCR4 rollover price control was a one-year price control intended to bridge the gap between the end of the fourth transmission price control review (TPCR4, 2007-2012) and the start of the RIIO-T1 price control (2013-2021).

1.8. In its Business Plan submission for the TPCR4 rollover price control, NGGT requested funding of £6.4 million for Feeder 9 stating that "*in response to the increased erosion of sediment in the Humber Estuary and exposures observed on our Feeder 9 pipeline, we are currently completing remedial activities to safeguard the structural integrity of this crossing. Given these remedial measures do not currently provide confidence that they shall form a permanent solution, there remains a requirement for us to progress a long term alternative to secure capacity in the Easington area*"[4].

1.9. In response to our Initial Proposals for the TPCR4 rollover price control, NGGT revised its request for funding stating that "*our understanding of the Planning Act requirement has grown allowing us to identify the extent of the activities we must undertake, together with their subsequent timings. We anticipate completion of the following key activities in 2012/13, totalling £4.9m … We have already sanctioned the first set of activities required to submit a Development Consent Order in accordance with the Planning Act and expect to sanction the remaining activities as required. The anticipated spend has been re-profiled to ensure we complete the key tasks and receive the required planning consents to proceed with the long term replacement of the current underwater pipeline*"[5].

1.10. We decided to allow funding of £4.8m for activities relating to planning permission for Feeder 9 as part of the overall asset health funding pot for NGGT in the TPCR4 rollover price control.

The RIIO-T1 price control (2013 – 2021)

1.11. In its Business Plan submission for the RIIO-T1 price control period, NGGT requested funding to construct a "*new pipeline [the Feeder 9 project] crossing*

[4] pg 40, National Grid Transmission TPCR4 Rollover Initial Proposals Response (not published)
[5] pg 41, *ibid*.

[…]within a tunnel of the River Humber. This project would cost approximately £100m-£150m"[6].

1.12. At the Initial Proposals stage, we were minded not to provide funding for the replacement pipeline at the time, citing uncertainty about costs and timing of the project. In our summary of the Initial Proposals we stated: *"For the Feeder 9 project we provided an ex ante allowance to enable NGGT to undertake preliminary engineering and licensing activities. Given the uncertainty and range of expected costs, we considered it appropriate that the remainder be funded (with the costs to be evaluated) via an uncertainty mechanism. The trigger for the uncertainty mechanism was NGGT being granted the appropriate planning approval"*[7].

1.13. We also said that NGGT's "*proposals in respect of these options are based on unit costs which we consider to be high. If our proposed unit costs for compressor stations and/or pipelines were to be used in option analysis, it is possible that a different solution could be chosen*" [8].

1.14. Finally, we noted that planning permission would be needed before any construction activity was started[9].

1.15. In our Final Proposals, we provided upfront funding of £6.6m to cover the costs of *"preliminary engineering and licensing activities"* [10]. We reiterated our position set out in our Initial Proposals that due to *"uncertainty and range of expected costs*[11]*"*, we proposed that funding would be re-evaluated as part of a reopener process, and that the *"trigger for the uncertainty mechanism was NGGT being granted the appropriate planning approval"* [12]. We also said in our Final Proposals that *"NGGT has not provided us with data to prove that the tunnelling solution and the respective linepipe will pose difficulties due to procurement costs and long delivery timelines"* and that *"we will assess the relevant costs upon NGGT having received the necessary permits and providing us with specific cost evidence".*[13]

Developments since our RIIO-T1 Decision

[6] pg 125, RIIO T1 Detailed Plan National Grid Gas Transmission (not published)
[7] pg 101, RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas (Cost assessment and uncertainty Supporting Document)
[8] pg 136, RIIO-T1: Initial Proposals for National Grid Electricity Transmission and National Grid Gas
[9] pg 137, *ibid.*
[10] pg 102, RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas (Cost assessment and uncertainty Supporting Document)
[11] pg 102, *ibid*.
[12] pg 102, *ibid*.
[13] Pg 102-103, *ibid.*

1.16. Since our RIIO-T1 Final Proposals decision in December 2012, NGGT undertook preliminary engineering and licensing work to progress its preferred option of building a tunnelled replacement for Feeder 9. It applied for a development consent order (DCO) for the tunnelled replacement in May 2015, which was granted in August 2016.

1.17. Internal management papers provided by NGGT show that the final investment decision for the tunnel project was taken in April 2016, and NGGT awarded the necessary main works contract in May 2016. Work on the tunnelled solution commenced in June 2016 (design works) and enabling works commenced in September 2016. NGGT informed Ofgem of the DCO approval in August 2016 and that it commenced tunnelling in May 2018.

1.18. NGGT expects to commission the new pipeline by June 2020 with all work associated with the pipeline to be completed by September 2021.

Impact Assessment

1.19. We consider our proposal to reject NGGT's application for funding for the Feeder 9 tunnelled replacement is important within the meaning of section 5A of the Utilities Act 2000 and as such necessitates an Impact Assessment (IA). However, as our consultation document and cost-benefit analysis (CBA) contain a thorough analysis of the issues, including the environmental impacts, we do not consider it necessary to publish a formal section 5A IA as it would be duplicative of the information contained in these documents.

Consultation Document Structure

1.20. The rest of this document is structured as follows:

- Chapter 2 considers the need for the Feeder 9 pipeline and looks at whether, in our view, NGGT has provided sufficient evidence to demonstrate that there is an ongoing need for the pipeline.
- Chapter 3 considers NGGT's case for replacing the current Feeder 9 pipeline, and describes our assessment of the case for replacement.
- Chapter 4 contains our review of NGGT's quantitative analysis and describes the analysis that we have carried out.
- Chapter 5 considers NGGT's decision-making process and also our initial views on whether NGGT's actions in relation to Feeder 9 are consistent with those of an efficient and economical operator.
- In Chapter 6, we discuss our initial view of the efficient costs of the two leading options, i.e. continued mitigation and the tunnelled replacement.
- Chapter 7 sets out our initial views on NGGT's application for additional allowances for replacing Feeder 9.

2. Is Feeder 9 required?

Chapter Summary
This chapter considers the need for the Feeder 9 pipeline and looks at whether, in our view, NGGT has provided sufficient evidence to demonstrate that there is an ongoing need for the pipeline.

Question box
Question 1: Do you have any views on our assessment of the need for Feeder 9?
Question 2: Do you have any views on the additional information provided by NGGT on the operational impact on the GB gas market of the loss of Feeder 9?

NGGT submission

2.1. This section sets out our assessment of the ongoing need for the Feeder 9 pipeline. Our assessment is based on the evidence provided by NGGT in its reopener submission, as well as information from other sources such as the annual Future Energy Scenarios (FES) published by National Grid[14].

2.2. NGGT's case for the ongoing need for the Feeder 9 pipeline is based on its assessment of the likely consequences of the loss of Feeder 9, either through failure or through pre-emptive isolation of the pipeline by NGGT. These consequences are broadly categorised as follows:

- Reduced capability: Network and entry capability.
- Reduced resilience.
- Wholesale gas price and consumer impact.
- Impact on the UK/Norway relationship.
- Operational impact on the GB gas market.

2.3. Shortly before this document was due to be published, we received additional information from NGGT on the operational impact on the GB gas market of the loss of Feeder 9 due to emergency isolation. The timing of this information meant that we were not able to take account of it in reaching our initial views. However, we have included in this section a summary of the information received from NGGT, and welcome stakeholders' views on it. We will take account of this information received from NGGT, and any information or views received as part of consultation responses, in reaching our final decision.

[14] NGGT's FES indicates a range of scenarios for energy outputs under different assumptions. More information is available here.

2.4. The remainder of this chapter sets out NGGT's submissions in respect of each of these categories and provides our initial views.

Reduced capability: Network and entry capability

2.5. NGGT has carried out network analysis to assess the impact of the loss of the Feeder 9 pipeline on its ability to transport gas from the Easington area into the rest of the National Transmission System (NTS) [15]. NGGT claims that the loss of Feeder 9 would lead to a reduced ability to transport gas from the Easington area.

2.6. NGGT's obligated entry capacity[16] across the Easington area is 201 million cubic metres per day (mcm/d). Actual peak gas flows from the Easington area have been around 150 mcm/d since 2010.

2.7. A large proportion of the gas from the Easington area is transported to consumers in the South and East of England across the Humber estuary through the Feeder 9 pipeline. NGGT's submission notes that the section of Feeder 9 that crosses the River Humber "*regularly transports between 70 mcm/d and 100 mcm/d*" [17]. The loss of Feeder 9 would mean that NGGT's capability to accept flows of gas into the Easington area is reduced from 187.1 mcm/d to 74.9 mcm/d.

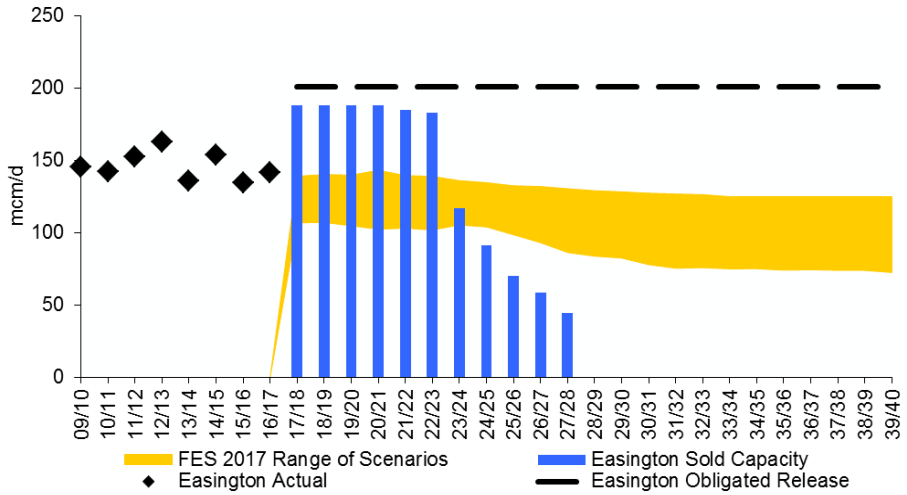
2.8. NGGT considers that the Easington terminal itself is "*one of the most utilised entry points on the network*"[18]. It is the UK's primary route of entry for Norwegian gas imports via multiple gas fields, and capable of accepting up to 130 mcm/d from the Ormen Lange gas field in the North Sea via the Langeled pipeline.

2.9. Actual entry capacity bookings at the Easington area until 2024/25 are higher than NGGT's assessed maximum network capability without Feeder 9 (i.e. 74.9 mcm/d). Actual capacity bookings beyond this date are below this level, however this could change at future capacity auctions.

2.10. Figure 1 is an extract from a chart provided by NGGT showing obligated, actual and sold capacity and the FES range of scenarios at Easington indicating required capacity.

[15] NGGT defines the Easington area as comprising two gas entry terminals (Easington and Theddlethorpe), four onshore storage sites (Caythorpe, Hornsea, Albrough and Hatfield Moor) and one offshore storage site (Rough).
[16] Obligated entry capacity is the baseline capacity NGGT is required by its licence to provide.
[17] pg 7, River Humber Gas Pipeline Replacement Project (Feeder 9)
[18] pg 21, *ibid.*

Figure 1 Obligated, actual and sold capacity at Easington and FES 2017 range of scenarios



2.11. NGGT considers that if it is unable to rely on Feeder 9 (due to loss or isolation), it would be unable to meet its contractual entry capacity commitments for between 78 – 103 days in a year.

Reduced resilience

2.12. NGGT considers that the loss of Feeder 9 would lead to a reduction in network capability along the UK's east coast, leading to an increased reliance on its assets on the west coast.

2.13. This would lead to an increase in running hours at a number of compressor stations, including those that are operating under restrictions in order to comply with emissions legislation.

Wholesale gas price and consumer impact

2.14. NGGT considers that the loss of Feeder 9 could result in a supply shock of a magnitude that has not been seen to date in the UK. Although it is challenging to predict the market response in the event of a supply shock of this nature, NGGT believes that the most likely outcome is a short-term spike in the price of wholesale gas followed by a smaller increase in the longer term price of wholesale gas.

2.15. Increases in wholesale gas prices are likely to cause increases in prices paid by gas consumers in the UK.

Impact on the UK/Norway relationship

2.16. According to data provided by NGGT, Norwegian gas imports accounted for approximately 35 per cent of UK gas supply in 2015.

2.17. The Langeled pipeline, which brings Norwegian gas into the Easington terminal, was built in 2006 at a cost of £1.7 billion. According to NGGT's submission, this pipeline was built "*with the expectation that there would be a continued need for, and ability to, bring Norwegian gas into the UK via the Easington terminal*"[19]. Moreover, NGGT expects further development in Norwegian gas fields in the foreseeable future, which are likely to utilise the Langeled pipeline.

2.18. In NGGT's view, the loss of Feeder 9 would reduce the volumes of Norwegian gas brought into the Easington area, with the Langeled pipeline not operating as intended. NGGT considers that this loss would risk damaging the collaborative working relationship with Norway.

Operational impact on the GB gas market

2.19. Shortly before publication of this document, NGGT submitted additional information and analysis on the operational impact of emergency isolation of Feeder 9 on the GB gas market.

2.20. According to the additional information provided by NGGT, any isolation of Feeder 9 would reduce east coast transmission capability from 120 mcm/d to 30 mcm/d, and constrain Easington area entry flows to 75 mcm/d, and would require significant market and physical intervention by the Gas National Control Centre (GNCC) to manage the immediate impact. If this occurred under winter conditions, NGGT may have to issue a Gas Deficit Warning, and undertake energy balancing and constraint management actions. Also, NGGT said that "*there is likely to be a need for the GNCC to take firm demand side actions targeting large industrial and connected power generation loads in the south in order to support system pressures until the NTS is stabilised and system balance restored*".

2.21. The timing of this submission meant that we were not able to take account of this information in reaching our initial view on the need for Feeder 9. However, we will take account of this information and any feedback received from stakeholders in reaching our final decision.

Our initial view

2.22. NGGT has based its assessment of the continued need for the Feeder 9 pipeline on actual and forecast usage of the network in the Easington area.

[19] pg 22, River Humber Gas Pipeline Replacement Project (Feeder 9)

2.23. We consider that the evidence provided by NGGT establishes the need for Feeder 9 in the short term, i.e. until 2025. Entry capacity bookings until 2025 at the Easington terminal exceed NGGT's estimate of network capability in the absence of Feeder 9. The loss of Feeder 9 is likely to mean that NGGT is unable to meet its contractual capacity obligations until 2025, and that could lead to supply disruptions and costs to consumers through gas price increases and capacity buyback costs.[20]

2.24. Current capacity bookings at Easington beyond 2025 are below the maximum network capability without Feeder 9, however these could change in the future if additional bookings are made.

2.25. To assess the need for Feeder 9 beyond 2025, NGGT has modelled flows in the Easington area beyond 2025 under various assumptions. These scenarios indicate that the maximum requirements in the Easington area to 2030 cannot be met without the pipeline.

2.26. NGGT produces its FES document each year, which sets out gas demand patterns in the future (up to 2050) under a range of credible scenarios.[21] However, supply sources for gas are not provided to the same time period.

2.27. While NGGT's FES show that imported Norwegian gas is likely to play an important role in the UK gas supply mix until 2050, there is considerable uncertainty about these long-term projections. For instance, these projections rely on assumptions about the evolution of future gas demand (including exports to continental Europe) and sources of gas supply (e.g. the development of alternative green gas sources such as biomethane and bio-mass derived synthetic natural gas (bioSNG), shale gas and imported liquefied natural gas (LNG)).

2.28. Taking all of the above information into account, our initial view is that, while the evidence provided by NGGT demonstrates that there is a clear need for the Feeder 9 pipeline in the short term (i.e. until 2025), there is some uncertainty about the need for Feeder 9 beyond this.

2.29. The current Feeder 9 was commissioned in 1984 and under normal circumstances, according to NGGT's own assumptions, it would have a life expectancy of 60 years. This means that unless the current Feeder 9 fails, or is isolated early, it would not need replacing until 2044 (i.e. 60 years from 1984).

[20] These are costs associated with making payments to gas shippers who hold entry capacity rights if those rights cannot be honoured, for instance due to network constraints. These are also called constraint costs in this document.
[21] There are four FES: 1) consumer power; 2) steady state; 3) two degrees; and, 4) slower progression. These scenarios are based on different levels of investment appetite and green ambition. They are explained further here.

2.30. The uncertainty about the long-term need for Feeder 9 means that there is a possibility that a like-for-like replacement of Feeder 9 may not be required at the end of the life of the current pipeline.

3. The case for replacing Feeder 9

In this chapter, we assess the case put forward by NGGT for replacing the existing trenched Feeder 9 pipeline with a tunnelled replacement.

Question box
Question 1: Do you have any views on our assessment of NGGT's case for the tunnelled replacement?
Question 2: Are there any additional factors we should consider as part of our assessment?
Question 3: Do you consider there is a safety case for replacing Feeder 9?
Question 4: What is your view of the risk from loss of lease?
Question 5: What is your view of the effectiveness of NGGT's mitigation approach?

Context

3.1. NGGT's submission for the 2018 reopener identifies a number of risks associated with the continued operation of the current Feeder 9 pipeline. These include:

- The risk of further river bed erosion around the current Feeder 9 pipeline, leading to an increased risk of pipeline damage through free spanning and third party interference (TPI)
- The risk to human safety through gas explosions caused by anchor strikes or vessel grounding
- The risk that the lease to operate the current Feeder 9 pipeline is lost due to a breach of lease conditions
- The risk that the current method of mitigation (i.e. concrete frond mattressing) is only a temporary solution
- Environmental considerations.

3.2. In many cases, NGGT has quantified these risks and their potential consequences and included them in its CBA. We have reviewed NGGT's CBA and discuss our findings in Chapter 4. We have also carried out our own quantitative analysis, the results of which are also presented in that chapter.

Needs Case

3.3. NGGT has stated in its engagement with us that it considers that Ofgem accepted the needs case for a tunnelled replacement of the existing Feeder 9 pipeline in 2012, and that the statements we made in our Initial and Final Proposals for the RIIO-T1 price control make this clear.

3.4. We do not agree that we have approved the needs case for the tunnelled replacement. In our RIIO-T1 Final Proposals, we acknowledged that there was uncertainty about costs and timings, and whether planning permission would be granted. Furthermore, we considered whether there were operational reasons (e.g. needing to procure items with long lead-times) for delaying a decision on funding until the two reopener windows (2015 and 2018) and concluded that there were none. In any event:

- NGGT appears to have ruled out ongoing mitigation as a solution without providing a strong justification. For example, we are not clear why it considers mitigation is only appropriate for 5-10 years given the success of these measures since 2010.
- NGGT has an ongoing obligation under section 9 of the Gas Act 1986 to develop and maintain an economical and efficient pipe-line system. Consistent with this obligation and good practice, we would expect NGGT to regularly evaluate its investment options to ensure that decisions are being made in the best interests of consumers.
- NGGT made its investment decision in 2016, which is 4 years after the design of the reopener in 2012. We think this is ample time to review the optimal solution, taking into account new information (e.g. the success of the mattressing), before committing significant sums to new investment.
- We think a detailed CBA should have been undertaken in advance of the investment decision to properly evaluate the merits of the options available. NGGT only did this in 2017 after it had made the decision. We also think that a CBA is an important step in demonstrating that a solution appropriately manages safety risks (as per safety requirements that risks be managed in an ALARP (as low as reasonably practicable) manner).

Further river bed erosion

3.5. NGGT's submission includes a risk of further river bed erosion around the current Feeder 9 pipeline. Movements in the river bed could adversely affect the depth of cover over the pipeline, leading to increased risk of pipeline damage. NGGT has identified two ways in which reduced depth of cover over the pipeline could lead to damage:

- **TPI**. Reduced depth of cover over the section of the pipeline that lies beneath the navigation channel[22] exposes the pipeline to the risk of damage or rupture as a result of an anchor strike or drag, or as a result of grounding or foundering of a passing vessel.
- **Free spanning**. Free spans occur when the soil that supports the pipeline is completely eroded away leaving sections of the pipeline unsupported. Free

[22] Approximately one kilometre of the pipeline lies directly below the navigation channel.

spanning sections of the pipeline are at risk of rupture or failure through Vortex Induced Vibration (VIV).[23]

3.6. According to NGGT, the consequences of TPI include:

- Risk to human life through an uncontrolled release of gas from the damaged pipeline causing an explosion that affects any vessels in the area.
- The risk of gas supply disruptions caused by the emergency isolation of Feeder 9, leading to increases in wholesale gas prices and constraint costs.[24]
- Costs associated with pipeline repair, shipwreck clear up and shipping disruptions.
- Damage to the Humber estuary ecosystem caused by gas release and subsequent repair works.

3.7. The consequences of free spanning are determined by the extent of the free span and NGGT's response as part of its risk management strategy. NGGT, as part of its mitigation approach, is currently carrying out bi-monthly inspections and surveys, which allow it to intervene early and take mitigating action. Moreover, the frequency of inspections and surveys can be increased if required. We now set out our understanding of NGGT's risk management strategy for free spanning risks.

3.8. In the event that further soil erosion occurs leading to pipeline exposure, NGGT would consider mattressing as a potential remediation method. Mattressing has proved to be successful in the past at stopping further erosion, even reversing it in some areas (approximately 100m).

3.9. In the event that further erosion takes place resulting in a limited (i.e. less than 20m in length) free span developing (either because previous mattressing has failed or that it occurs between surveys), NGGT would consider further remediation including the option of placing mattresses in the affected area.

3.10. In the event that this mattressing fails or is not carried out in time, a more extensive free span (i.e. greater than 20m) could develop. At this point, NGGT would isolate the pipeline as a precautionary measure. If the free span is less than 55m, NGGT would carry out further mitigation work and monitor the outcome. If the depth of cover stabilises or recovers (i.e. remediation is successful), NGGT would start operating the pipeline again.

[23] Vortex Induced Vibration (VIV) occurs when the free span of pipe amplifies the natural frequency of the structure to create resonant vibrations. These oscillations can rapidly increase in magnitude, leading to fatigue and failure with little to no warning. NGGT has estimated that a minimum free span of 55m, coupled with water velocities of over 2.6m/s is required before VIV can occur on the current Feeder 9 pipeline.

[24] See the explanation of capacity buyback costs in footnote 20.

3.11. If the emergency mattressing does not work and there is further erosion, i.e. the free span increases to 55m or more, the pipeline would remain isolated as a precautionary measure to prevent pipeline rupture due to VIV, and then further remediation work would be undertaken. If this is not possible, NGGT would permanently decommission the current Feeder 9 pipeline and consider alternatives, including constructing a replacement.

3.12. If the pipeline had to be isolated or permanently decommissioned, there would be a short/medium-term disruption to gas supply, which could lead to increases in gas prices and constraint costs. This disruption would be likely to last until either the pipeline is brought back into service, or alternative supply routes are found (which may include building a replacement pipeline).

3.13. Our initial view is that NGGT's approach to managing the integrity of the pipeline, i.e. frequent inspections and mitigation where needed, means that it is extremely unlikely that the pipeline would suffer damage from free spanning causing an escape of gas. The pipeline would be isolated or decommissioned before that could happen. In addition, no risk to human health or safety from free spanning has been identified by NGGT.

3.14. NGGT has quantified its view of the risks associated with further river bed erosion and takes account of them in its CBA, which we discuss in the next chapter.

Comparisons with Feeder 1

3.15. NGGT has drawn parallels with its Feeder 1 pipeline (located in the vicinity of Feeder 9), which was isolated in July 2009 once significant free spanning was discovered. In July 2010, the Feeder 1 pipeline was found to have failed and the unsupported section collapsed and came to rest on the river bed.

3.16. We consider there are important differences between the two pipelines, which mean that the observed failure of Feeder 1 need not be repeated for Feeder 9. Free spanning was first observed on Feeder 1 in 1999 before any mitigation could take place. Mitigation in the form of rock dumping (not mattressing) was carried out in 2000 and 2002. Further increases in free span lengths were observed between 2004 and 2008. In contrast, for Feeder 9 NGGT is carrying out bi-monthly surveys which will identify early any at risk areas, meaning that early mattressing can be done, significantly reducing the probability of further erosion and then free-spanning occurring.

3.17. In addition, as a significantly larger pipeline than Feeder 1, the water velocity required to cause structural damage to Feeder 9 is significantly higher. NGGT's submission notes that for VIV to occur, water velocities of 2.6m/s and a 55m free

span section would need to be observed in the same place[25]. However, maximum measured water velocities around the Feeder 9 pipeline were 1.85m/s[26], with a 1-in-100[27] year maximum of 2.6m/s[28].

The safety aspects of Feeder 9

3.18. NGGT operates under a statutory framework relating to health and safety that includes duties to comply with applicable legislation. Some of these duties cover the operation of the current Feeder 9 pipeline. Of particular relevance to this reopener is NGGT's duty to manage the risk to human health from the continued operation of the pipeline. Regulation of NGGT's compliance with its duties in this regard falls within the purview of the HSE.

3.19. As part of its case for replacing the current Feeder 9, NGGT has highlighted the risk to human safety arising out of possible TPI damage. NGGT has quantified and monetised this risk using industry standard approaches to risk assessment. This monetised risk value has been included in NGGT's CBA. NGGT considers that there is little or no risk to safety through pipeline rupture caused by free spanning because of its current pipeline inspection and management regime.

3.20. As part of our assessment of NGGT's reopener submission, we consulted the HSE and requested a review of the safety aspects of NGGT's case. In particular, we asked the HSE to provide its view on:

- Whether NGGT's operation of the current Feeder 9, and its approach to risk management, is consistent with its duties under applicable health and safety legislation.
- Whether NGGT's CBA appropriately takes account of the risk to human life from the continued operation of the current Feeder 9.

3.21. The HSE reviewed NGGT's reopener submission and the associated CBA documents and spreadsheets and provided a report[29].

3.22. The HSE's report concluded that:

- NGGT's arrangements for dealing with incidents and emergencies relating to the current Feeder 9 pipeline are satisfactory.

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[25] pg 18/19, River Humber Gas Pipeline Replacement Project (Feeder 9)
[26] pg 15, Pipeline Span VIV Assessment: No.9 Feeder, ABP Mer (not published)
[27] 1-in-100 means that there is a 1% probability (or a 1-in-100 chance) of the maximum water velocity in any year reaching 2.6 m/s.
[28] pg 5, Pipeline Span VIV Assessment: No.9 Feeder, ABP Mer (not published)
[29] Review of National Grid Gas Transmission Gas Feeder 9 Optioneering on behalf of Ofgem (published alongside this document)

- NGGT's arrangements for managing the risk of free spanning are adequate and meet the requirements to maintain the integrity of the current Feeder 9 pipeline. However, these arrangements should be kept under review and appropriate action taken based on pipeline inspections.
- There remains a credible threat of damage to the current Feeder 9 pipeline from TPI, particularly anchor strikes. The HSE notes that concrete mattresses are not designed as an impact protection measure, and do not provide adequate protection from anchor strikes. The HSE notes that NGGT has taken steps to inform the Humber Port Authority and has provided charts to them. A "no-anchor zone" has been created in the vicinity of the current Feeder 9 to reduce the risk of TPI[30]. NGGT in its analysis has assumed that the probability of a TPI event that causes a pipeline rupture is equivalent to one in every 3,200 years.
- The HSE has reviewed the analysis provided to us by NGGT and concluded that the risk to human life from TPI is within the "tolerable if ALARP" range[31]. This means that the HSE would not normally insist that NGGT reduces this risk further if the risk is ALARP, which it would be if the net cost of building the tunnelled replacement exceeds £5.11m (in 2009/10 prices, taking account of other costs and benefits to NGGT and consumers from building the tunnel)[32].

3.23. In light of the HSE's conclusions, we take the view that the safety case for replacing the current Feeder 9 with a new tunnelled pipeline is only valid if the additional net cost incurred, taking account of all other reasonable costs and benefits to consumers and NGGT, is below £5.11m (in 2009/10 prices). We assess the other costs and benefits to the consumer as part of our quantitative analysis, which is described in Chapter 5.

Loss of lease

3.24. NGGT holds a lease granted in 1984 by the Association of British Ports (ABP), which is the Competent Harbour Authority for the Humber estuary, to lay and operate the current Feeder 9 in the Humber estuary. The lease expired in 2016, however we understand that NGGT is in negotiations with ABP to extend the lease. NGGT's rights under the original lease would continue automatically until it is revoked or a new lease agreed.

3.25. NGGT's submission states that it cannot always meet one of the requirements of its lease, namely to ensure Feeder 9 has a minimum depth of cover below the river bed (approximately 1.8m). Given this, NGGT has identified a risk that the lease

[30] pg 19, River Humber Gas Pipeline Replacement Project (Feeder 9).
[31] A risk that is characterised as "tolerable if ALARP" is only acceptable if it can be demonstrated through a comprehensive CBA that the risks are "as low as reasonably practicable", i.e. the risk can only be reduced further at a grossly disproportionate cost. In the gas transmission sector, a "gross disproportionality factor" of 10 is applied.
[32] These costs and benefits are accounted for in Ofgem's CBA, which is published alongside the consultation document.

to operate the pipeline may be lost. NGGT is unlikely be able to operate the current pipeline if it lost the rights granted under that lease and was unable to secure equivalent rights through other means.

3.26. In its submission to the Planning Inspectorate in response to NGGT's planning application for the new tunnelled replacement, ABP said that:[33]

"There have also been discussions with regard to the proposed renewal of the existing Underlease and the proposed Supplemental Underlease. As to whether ABP will be agreeable to the renewal of the Underlease etc. will be dependent upon the physical state of the existing pipeline nearer to the date of renewal. On the basis that the pipeline is in a satisfactory condition it is anticipated that ABP will be agreeable, subject to ABP Harbour Authority and Crown Estate approval, to the renewal of the Underlease etc. for a period to be agreed and to be consistent with the period required for the construction of the new tunnel and the commissioning of the pipeline to be laid therein to ensure continuity of supply. Upon successful commissioning of the tunnel/new pipeline it is presumed that the existing pipeline will become redundant in which case removal of the same, is considered appropriate to ensure there are no future navigational safety implications."

3.27. We accept that there is a risk that NGGT's rights under the lease may be restricted or, or in extreme circumstances, lost if conditions around the pipeline were to change in the future such that the pipeline poses an unacceptable risk to other users of the Humber estuary. However, we do not consider that the evidence provided by NGGT to date substantiates the view that this risk is currently at an unacceptable level, or that it is likely to reach those levels in the foreseeable future. As stated in the next section, pipeline inspections and river bed surveys have indicated that previous mattressing rounds have been successful and there are no sections of the pipeline that require immediate attention. Moreover, there are no indications that the river bed conditions are expected to worsen in a way that justifies replacement of the pipeline.

3.28. As indicated in ABP's statements to the Planning Inspectorate, provided the pipeline is maintained in a satisfactory condition, it would not object to the continuation of the lease for at least the length of time required to build a replacement (which is a minimum of five years - and perhaps longer). Given that the risk from the existing pipeline each year is the same regardless of whether a new tunnel is under construction or not, there is no reason to assume that the lease would be revoked while the pipeline is maintained satisfactorily.

3.29. Given this, on the basis on the information before us, we currently see no reasonable grounds to assume that the lease would be lost in the near future, or that pre-emptive action to replace the pipeline is warranted for this reason.

[33] Update of ABP's discussion with NGGT to the Planning Inspectorate

Current mitigation approach

3.30. The placing of concrete frond mattresses over sections of underwater pipelines that are at risk from erosion is a widely used industry standard method of pipeline protection. Concrete mattresses have been used extensively to protect undersea cables and pipelines, particularly in the North Sea.

3.31. Concrete frond mattresses are high-strength concrete segments linked together to form a continuous, flexible concrete barrier. Plastic fronds on the concrete mattresses help gather silt and sand to provide an additional barrier against erosion (see Figure 2 for images of these frond mattresses).

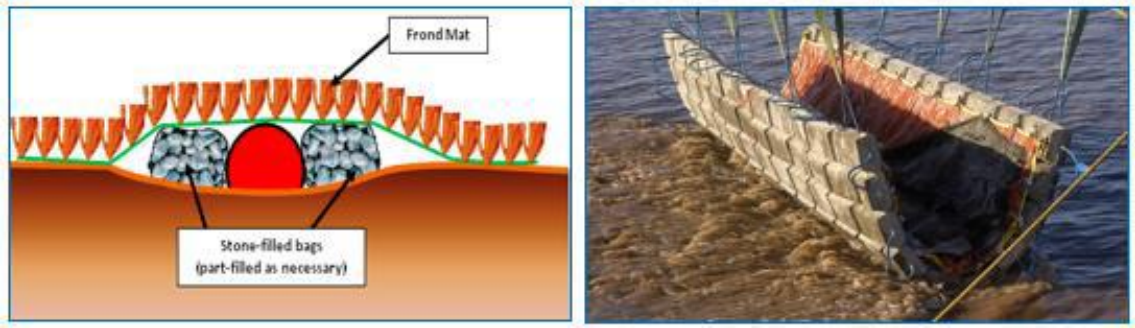

Figure 2 Concrete frond mattressing in the River Humber (from NGGT submission)

3.32. NGGT carried out two rounds of mattressing on exposed sections of Feeder 9, in 2009/10 and again in 2013. Recent river bed surveys carried out for NGGT indicate that the mattressing has been successful and there are no areas around Feeder 9 that require immediate attention.

3.33. NGGT has said that mattressing is only a temporary solution that is effective for 5-10 years, and that a long-term solution, in the form of a replacement pipeline, is needed to address the risks to the current Feeder 9. This claim is based on findings reported in a seabed survey report[34] produced for National Grid by ABPmer[35] in 2012.

3.34. However, a 2010 study carried out by ABPmer considered a number of options for temporary remediation, and concluded that "[the combined use of concrete frond mattresses and rock-filled bags] *is considered to be the most likely form of remediation to provide a successful long-term solution to the ongoing problem of local erosion*" and due to the lack of evidence at the time of how this solution would

[34] Humber Pipeline Protection: Monitoring Update (2012) (not published)
[35] ABPmer is a wholly-owned subsidiary of Associated British Ports Holdings Ltd, which also owns Associated British Ports (ABP), the largest port operator in the UK.

work in the environment of the Humber estuary, recommended "*an initial trial placement*" together with "*an appropriate monitoring programme*". The report also states that even the most basic form of temporary remediation, i.e. "rock dump remediation" (not mattresses) "*will offer protection to the covered pipeline section for at least a 10-year period (if not longer)*"[36].

3.35. The "Final Strategic Options Report – October 2012" that was submitted by NGGT to the Planning Inspectorate states that "*the remediation work is proving to be very successful with the frond mattresses encouraging sand and silt to settle with indications of up to 0.5m increase in depth over the pipeline*"[37] and refers to the 2010 ABPmer study to claim that this method "*is only considered to be a relatively short term (up to 10 years) solution*". However, as set out above, we believe the 2010 ABPmer report makes this statement about "rock dump remediation", not concrete frond mattressing and rock-filled bags.

3.36. The HSE report published alongside this consultation finds that NGGT's approach of frequent inspections along with the use of concrete frond mattresses to be adequate protection against free spanning. Published guidance from the HSE to pipeline operators on protecting pipelines from anchor hazards includes the use of concrete frond mattresses as a form of protection that can be effective against strikes by all but the largest of anchors.[38] We also note that, in its report to us, the HSE says that there remains a credible threat of damage to the current Feeder 9 pipeline from TPI, particularly anchor strikes, and that concrete mattresses are not designed as an impact protection measure, and do not provide adequate protection from anchor strikes.

3.37. While NGGT's submission provides that mattressing is a temporary solution that would last for 5-10 years, it also states that concrete frond mattresses have been previously used on subsea pipelines and the materials have a long-term life expectancy.

3.38. NGGT holds a licence granted by the Marine Management Organisation (MMO) that allows it to carry out up to eight rounds of additional mattressing on Feeder 9 between now and 2035, if required. Mattresses have already been successfully placed over 750m of the existing Feeder 9 pipeline as part of the first round in 2010 (which covers almost the entire width of the navigation channel), and recent survey reports (the most recent report provided us with the results of the November 2017 survey) have consistently shown that there are no areas around Feeder 9 requiring immediate attention.

[36] pg 43, Needs Case: River Humber Gas Pipeline Replacement Project
[37] pg 5, Final Strategic Options Report – October 2012
[38] pg 13, Guidelines for pipeline operators on pipeline anchor hazards (HSE)

Environmental considerations

3.39. NGGT considers that the Humber estuary and its ecosystem is home to a number of protected species of fish and migratory birds. According to NGGT, a release of gas due to pipeline damage and any subsequent repair works could cause disruption to them and could potentially have a knock-on effect on the whole ecosystem.

3.40. As noted above, NGGT currently holds a licence from the MMO to carry out mattressing on the current pipeline when required. In its licence application to the MMO, NGGT submitted an environmental assessment of the impact of pipeline maintenance activities. This assessment looked at the potential impact of emergency mitigation work on the Feeder 9 pipeline and concluded that the activities "*will not have any significant impacts on any aspect of the receiving environment*"[39].

Conclusion

3.41. We disagree that we have accepted the needs case for the tunnelled replacement of Feeder 9. In any event, for the reasons set out above, our initial view is that NGGT should have continued to assess the need for a replacement of Feeder 9, including considering the option of continued mitigation.

3.42. NGGT has pointed to a number of risks associated with continued operation of the Feeder 9 pipeline. While we accept that these risks may exist, based on our qualitative review, we do not think the evidence before us points towards the need to replace the pipeline now.

3.43. In the next chapter, we look at the quantitative analysis carried out by NGGT (retrospectively), and discuss the outcome of our review of that analysis. We also present the results of our analysis.

[39] pg 21, Martine Licence Application Supporting Document Humber Gas Pipeline Maintenance (not published)

4. Quantitative analysis and comparison of options

Chapter Summary: In this chapter we describe and assess the quantitative analysis produced by NGGT to justify its decision to proceed with a tunnelled solution. After our assessment, we explain our own analysis (which is published for review) and the guidance provided by the HSE in its analysis of NGGT's decision.

Question box
Question 1: Do you agree with our assessment of NGGT's analysis?
Question 2: What are your views on our CBA model and assumptions?

Context

4.1. NGGT has undertaken quantitative analysis to support its application for funding for the replacement pipeline. The application included the results from a CBA that uses a methodology developed for NGGT called "Extreme Value Analysis" (EVA), implemented through a proprietary software package. In response to a request from Ofgem, NGGT provided a second CBA that uses a more traditional approach, implemented in an Excel spreadsheet.

4.2. While both methods use a risk-adjusted approach to estimating the costs and benefits of the different options, the EVA approach uses a Monte Carlo simulation with a probability distribution to calculating these estimates[40], whereas the traditional approach relies on central estimates of probabilities.

4.3. NGGT's analysis compares the cost of building the replacement for the current Feeder 9 (the "tunnel option") against a number of alternatives, including continued operation of the current Feeder 9 (the "mitigation option").

[40] The Monte Carlo simulation runs the simulations based on the set parameters (in this case a decision-tree framework) and provides different probabilities for different scenarios. To do this it relies on repeated random sampling in a particular probability density function.

NGGT's EVA CBA

Submission

4.4. NGGT's submission includes a comparison of costs and benefits of different options for Feeder 9, based on a CBA commissioned from a third party (Business Modelling Associates) and reviewed by academics from Cranfield University[41].

4.5. This CBA uses EVA, which is a method of quantifying costs and benefits under extreme uncertainty, to model the impact of so-called "high impact low probability" events. It is based on Monte Carlo simulations carried out within a decision-tree framework. The Monte Carlo simulations require a number of assumptions about the probabilities of various events occurring, expressed as the combination of a range and a probability density function within the range.

4.6. The EVA CBA compares the costs and benefits of five options:

- Stop Tunnel in 2016 and Mitigate.
- Stop Tunnel in 2017 and Mitigate.
- Tunnel replacement started in 2012.
- Trench replacement started in 2012.
- Stop Tunnel in 2016 and build Trench.

4.7. Please see the full report[42] and NGGT's submission for more information about the CBA methodology and the options considered within it.

Our view

4.8. On the basis of the materials presented to us, we have the following concerns about the EVA CBA:

- The model was built using proprietary software that was not available to us. This means that we were unable to carry out a thorough review of the assumptions, the calculations and the overall model structure.
- The model was accompanied by a written report that described the analysis and assumptions, but the report did not include all of the assumptions used in the model. Instead, the report only covered a selected subset of assumptions used. The report included a set of complex diagrams that attempted to explain the model structure, but we were unable to read it in the form presented in the report.
- The report contained little or no explanation of the basis for the specific decision tree used in the model. The results are highly sensitive to the choices made

[41] EVA CBA Final report 12_04_18 (published alongside this document)
[42] *Ibid.*

about the nodes of the decision tree and the branches coming out of each node (including the probabilities attached to each node/branch combination).

4.9. These issues meant that we were unable to carry out a comprehensive review of the assumptions or calculations in the EVA model. We engaged extensively with NGGT both before and after submission of its reopener application to obtain clarification and further information. We hosted a modelling workshop where NGGT was invited to present the analysis carried out. We received a number of supplementary spreadsheets and documents as part of this engagement. While these helped clarify some aspects of the model, there remain considerable issues with transparency.

4.10. However, the additional engagement with NGGT on the model allowed us an opportunity to critically review some of NGGT's assumptions. Following this review, we raised a number of supplementary questions, one of which resulted in NGGT identifying a serious error in model logic and assumptions. NGGT then issued a short update to the CBA report. However, a number of our concerns with the assumptions remain unresolved. We consider that these errors, coupled with the overall lack of transparency, cast considerable doubt on the reliability of the EVA model and its results.[43]

4.11. We commissioned an independent external review of the EVA methodology and its application to the Feeder 9 case. The review was carried out by a member of our academic panel of advisers. The adviser's report is published alongside this consultation[44].

4.12. The independent review made a number of observations about the methodology and its implementation, and concluded that the model results are sensitive to a number of key assumptions, and *"tiny differences in probabilities"*[45] drive the differences in the costs and benefits of different options. Under these circumstances, the review recommends that the investment case should not rely solely on the results of the EVA CBA, but should also consider other approaches such as a more traditional CBA.

4.13. We consider that the EVA methodology and its ability to inform investment decisions is severely compromised as a result of the lack of transparency and the extreme sensitivity of results to different subjective assumptions. Combined with the fact that the methodology is novel and untested, we do not consider it, on its own, to

[43] The EVA model erroneously assigned the same probability (i.e. 46%) for ship damage whether it is caused by an anchor strike or free spanning. This ignores the fact that a ship is more likely to be present in the vicinity of the pipeline in the case of anchor strike than in the case of free spanning (which could happen spontaneously and at locations outside of the narrow navigation channel). NGGT accepted that this was an oversight.
[44] Extreme Value Analysis (EVA) methodology used for cost-benefit analysis (CBA) by Dr Robert Ritz (published alongside this document)
[45] pg 4, *ibid.*

be developed enough to provide a sound basis for informing high-value investment decisions.

NGGT's Traditional CBA

Submission

4.14. In light of our concerns and those expressed by our independent academic adviser, we asked NGGT to submit a more traditional Excel-based CBA to support its case for replacing the current Feeder 9. NGGT then submitted a simpler Excel-based CBA, which relied on the same parameters as the EVA CBA, with two key differences:

- The traditional CBA does not use a Monte Carlo simulation to model uncertainty. It models a single scenario using central estimates for various probabilities.
- The traditional CBA is implemented in Excel, which makes the assumptions and calculations more transparent, allowing us to better review and understand them.

4.15. The traditional Excel-based CBA provided by NGGT compares the costs associated with the two lead options, reduced from five in the EVA CBA.

- Build tunnel in 2012 (the "tunnel option").
- Stop tunnel and mitigate from 2016 (the "mitigation option").

4.16. NGGT's model takes account of the following costs within the overall cost of the tunnel option:

- The cost of constructing a replacement Feeder 9 pipeline through a tunnel. These costs are expressed in terms of its impact on NGGT's allowed revenues over the expected lifetime of the tunnel (i.e. 60 years).
- This option also includes all of the costs of the mitigation option during the period of tunnel construction, until the expected commissioning date (2021).
- The annual cost of inspecting and maintaining the new pipeline.

4.17. The mitigation option, which assumes that the current Feeder 9 pipeline would be retained in service, includes the following costs:

- The estimated cost of regular pipeline and river bed inspections.
- The estimated cost of taking mitigating action if further river bed erosion is detected (i.e. placing concrete mattresses over the pipeline to encourage the build-up of sediment).
- The estimated impact on gas consumers of supply disruptions caused by an unexpected closure of Feeder 9 (i.e. through higher gas prices and constraint costs).
- The estimated monetised cost of potential human fatalities through a catastrophic failure of the pipeline.

- NGGT has assumed that the lease to operate the current Feeder 9 pipeline would be lost with a certain probability. If that were to happen, NGGT assumes that a replacement pipeline would need to be built immediately and the current pipeline would remain operational until the replacement pipeline is commissioned. The cost of pipeline replacement (multiplied by the probability of losing the lease) is added to the cost of the mitigation option.
- Other costs following a TPI incident that causes pipeline rupture, such as those arising out of disruptions to shipping, clearing of a shipwreck etc.
- "Sunk" costs relating to expenditure that NGGT says it has incurred in building the tunnelled replacement in 2016.
- "Routine mattressing" costs, assuming NGGT would carry out pre-emptive mattressing once every five years.
- The "terminal value" of ongoing costs and risks associated with continued operation of the current pipeline. This terminal value is the discounted value of these costs assuming they would continue to be incurred forever.

Our view

4.18. We have reviewed NGGT's analysis of the costs associated with both options, and have a number of concerns as set out below.

4.19. The CBA assumes that, under the mitigation option, the current pipeline would be operational for a further 60 years, which is the assumed lifespan of the replacement pipeline. The current pipeline was commissioned in 1984, and under the same lifespan assumption, it would need replacing by 2044. The inclusion of the "terminal value" implies that NGGT has assumed that the life of the current Feeder 9 would be extended indefinitely. We believe that the current Feeder 9 pipeline cannot be operated forever, and that, depending on the need for the pipeline in the future, would either be decommissioned (if it is not needed) or replaced (if it reaches the end of its life). Given NGGT's standard assumption of a 60-year asset life for pipelines, we consider it is unreasonable to assume that the current pipeline would last beyond 2044 (given that it was commissioned in 1984).

4.20. We do not consider it is appropriate for NGGT to include "sunk" costs in its comparison of options. We think the relevant question for us to consider is what action would an economic and efficient operator have taken before taking its final investment decision and thus before incurring what are now "sunk" costs. We think this approach is in consumers' interests as it only exposes consumers to efficiently incurred costs. In doing so, the CBA is a tool to identify the most efficient option for consumers, whether that is replacement or continued mitigation. Removing the "sunk" costs significantly lowers the net present costs for the mitigation option and has a significant effect on the results of the model.

4.21. We do not consider routine mattressing costs should be included in the CBA. NGGT has not historically carried out mattressing as a matter of routine nor does it plan to. Mattressing is only carried out when an area of a pipeline is exposed (or at risk of imminent exposure) and indeed, NGGT has not informed us about any routine mattressing carried out on Feeder 9 in the first 25 years of operation of the pipeline

until 2009, when pipeline exposure was observed. The costs associated with mattressing done in response to soil erosion are included elsewhere in the CBA. Removing routine mattressing costs lowers the net present costs of the mitigation option.

4.22. We believe that the loss of lease scenario has been incorrectly modelled by NGGT. NGGT's modelling framework assumes that if the lease to operate the current pipeline is lost, NGGT would need to construct a replacement pipeline (through a tunnel). The consequences of a loss of lease have been modelled by including an expected value of pipeline replacement costs (i.e. the probability of loss of lease in any year multiplied by the expected cost of building a tunnelled replacement).

4.23. NGGT's modelling uses a constant annual probability of loss of lease for this calculation, which does not take account of the possibility that the lease would have been lost in previous years. The lease to operate the pipeline can only be lost once – once it has been lost, it cannot be lost again. Once the lease has been lost, and the replacement pipeline built, it is no longer necessary to include the risks relating to free spanning and TPI in the analysis. NGGT's analysis does not make an adjustment to the costs of the mitigation option to reflect this. NGGT's approach overvalues the net present costs of the mitigation approach by suggesting a static monetary value for the loss of lease when in fact it should be decreasing.

4.24. We have a number of additional concerns about NGGT's assumptions at a more granular level. These concerns cover both the probabilities of various adverse events occurring and the cost associated with the consequences of those events. For instance:

- NGGT assumes that there is a 35% probability that the pipeline would be exposed in any year. The pipeline has been in service since 1984. Pipeline exposure was observed once in 2009 and again in 2013 (a small area of erosion was observed in the vicinity of the area previously covered in 2010). No exposures have been observed since. Given this history, it appears excessive to assume that the annual probability of pipeline exposure is 35%.
- NGGT assumes that a free span of less than 20m would develop with an annual probability of 12.25% (equivalent to once in eight years). A free span requires significantly greater volumes of river bed soil to be eroded away compared to pipeline exposure. Given that a free span can only develop once the pipeline is exposed, NGGT's assumption implies that 1-in-3 exposures would turn into free spans. We have some concerns with this conclusion. NGGT is carrying out frequent (bi-monthly) river bed inspections, and it can increase the frequency of inspections if needed. In order for a free span to develop, it would either have to develop so quickly that it happened between inspections, or if had been spotted, it happened in spite of mattressing or any other remedial work that NGGT would have done. While it is not easy to estimate the "correct" probability for such events, we consider NGGT's assumptions are excessive.

4.25. Our technical advisers reviewed a number of assumptions relating to the probability of free spanning and TPI occurring on the current Feeder 9 pipeline.

NGGT's results are highly sensitive to these assumptions, and therefore these merited additional review. Our advisers shared our concerns that NGGT's assumptions appear pessimistic. These views take account of the following:

- The current Feeder 9 pipeline is buried in a deeper trench than Feeder 1, and has never experienced free spanning.
- Concrete mattresses are known to successfully mitigate scour events (i.e. pipeline exposure through erosion). Given that NGGT has recently successfully undertaken mattressing, the process for doing so should be well-established and NGGT should be able to respond relatively quickly to future scour events.
- The pipeline and river bed are being inspected regularly (once every two months) and therefore any erosion can be detected quickly.

4.26. Moreover, the results from recent pipeline and river bed surveys indicate that the previous mattressing rounds have been successful. Recent survey reports provided to us (from 2016 and 2017) provide that there are no areas around Feeder 9 that require immediate attention.

Ofgem's CBA

4.27. In order to test the sensitivity of NGGT's results to these assumptions and the robustness of its conclusions, we developed our own Excel-based CBA model (published alongside this consultation). The model uses and builds on NGGT's own modelling framework. Where we considered there to be good reason to deviate from NGGT's assumptions, we have done so.

4.28. The main areas where we have deviated from NGGT's assumptions are the probabilities of pipeline exposure and free spanning. As set out in the previous section, we have a number of concerns with NGGT's assumptions and have developed alternative assumptions that we think are more in line with historical scouring events and NGGT's risk management strategy. Recognising the inherent uncertainty in estimating these probabilities based on limited historical information, we have applied what we consider are reasonable upper and lower bounds for these values. Furthermore, Ofgem's Chief Engineer has reviewed both NGGT's and our assumptions and has provided a view on them(please see Appendix 2).

4.29. In some cases, we have adopted values for parameters that increase the estimated risk of the mitigation option. For example, during our assessment of NGGT's submission, we identified an issue with NGGT's CBA model that had the effect of understating the gas price impacts of the loss of Feeder 9, relative to our calculations. We have used our calculations, with the higher impact, for our assessment.

4.30. The following table sets out a list of key assumptions where we have disagreed with NGGT's view and our rationale for doing so.

Table 1 Key assumption differences between NGGT and Ofgem

Assumption	NGGT's assumption	Our view	Rationale
Annual probability of pipeline exposure through river bed erosion	35.00%	Lower bound 5.80% Upper bound 20.00%	NGGT's assumption implies that the pipeline would be exposed every three years. Given the history of the pipeline and the length of its service (since 1984), we consider this to be an overestimate. Our upper bound is based on one exposure event every five years (based on NGGT's statement that mattressing is likely to be effective for 5-10 years). The lower bound is based on two exposure events every 34 years (the period between 1984 and 2018).
Annual probability that a free span of less than 20m develops	12.25%	Lower bound 0.58% Upper bound 2.00%	The range is calculated based on the probabilities that erosion causes pipeline exposure and an assumption that a regular inspection regime is in place and there is a 10% probability that a developing pipeline exposure has not been detected or that it has been detected and no action was taken in time.
Annual probability that a free span of between 20m and 55m develops	2.38%	Lower bound 0.12% Upper bound 0.40%	The range is based on the assumption that free spans of this length are formed progressively from a smaller free span. There is an effective

Assumption	NGGT's assumption	Our view	Rationale
			inspection and mattressing regime in place, and there is a 20% probability that mattressing done in response to a <20m free span has failed to stop or reverse the progression of the free span.
Annual probability that a free span of greater than 55m develops	0.51%	Lower bound 0.02% Upper bound 0.08%	This range is based on the assumption of a 20% probability that any intervention done in response to a <55m free span (which may involve more than one round of mattressing) is not successful and the free span increases in length to greater than 55m.
Starting probability that the lease would be lost in any year	0.83%	0.97%	We disagree with the way the loss of lease scenario has been modelled by NGGT. We have revised the methodology and adjusted the starting annual probability upwards to 0.97%. This implies that there is a 20% probability that the lease would be lost and a replacement pipeline built by 2044. Our approach results in a similar cumulative probability of loss of lease by 2044 as under NGGT's approach.
Probability that the loss of Feeder 9 occurs in the winter peak demand period such that there is a high impact on	50%	Lower bound 21.4% Upper bound 28.2%	We disagree with NGGT's 50% assumption. Our assumptions are based on NGGT's own figures that show that a loss of Feeder 9 would lead to system capability

Assumption	NGGT's assumption	Our view	Rationale
wholesale gas prices			constraints for between 78 and 103 days in a year. These provide our lower and upper range.
Weighted average cost of capital (WACC) for calculating the revenue impact of expenditure on Feeder 9 replacement	4.38% over the life of the tunnel (60 years)	Lower bound 1.27% Upper bound 3.62%	The assumed WACC affects the lifetime cost of the tunnel. For a given discount rate, the higher the WACC, higher net present cost (NPC) of the tunnel option. We think NGGT's assumed WACC of 4.38% is too high and is inconsistent with available information on the different constituent elements of the WACC (i.e. cost of equity and cost of debt) over the relevant time horizon. We have used a range based on plausible upper and lower limits for the long-term WACC The upper limit is based on a cost of debt of 2.15%, a cost of equity of 5.08% and notional gearing of 50%. The lower limit is based on a cost of debt of 0.30%, cost of equity of 3.07% and notional gearing of 65%. These figures are taken from CEPA's February 2018 report for Ofgem on the cost of capital

Assumption	NGGT's assumption	Our view	Rationale
			for the upcoming RIIO-2 price controls.[46]
Capital cost of the tunnel option	£139.8m	Lower bound £94.6m Upper bound £114.6m	NGGT's assumption uses its proposed adjustment to expenditure allowances for the tunnel. Following our assessment of NGGT's submitted costs, we have come an initial view of the efficient costs of the tunnel (i.e. £104.6m). Our upper and lower bounds reflect this figure +/- £10m to take account of uncertainty in the actual costs.

4.31. NGGT's submission sets out the results of its modelling using the EVA approach. Using this approach, the estimated net present costs (using a 60-year horizon for the tunnel) of each option are:

- Tunnel 2012 option: Net Present Cost (NPC)[47] of £214m.
- Trench 2012 option: NPC of £267m.
- Mitigate 2016 option: NPC of £292m.

These results imply that the tunnel option is cheaper than the mitigation option by £78m.

4.32. As set our earlier in this chapter, we had raised a number of issues and concerns with the modelling carried out by NGGT. In response, NGGT submitted a more traditional Excel-based CBA which looked at the two lead options (tunnel vs mitigation). The results from this model are provided below:

46 https://www.ofgem.gov.uk/system/files/docs/2018/03/cepa_report_on_baseline_allowed_returns_for_riio-2.pdf

47 We have used the term "net present costs" to describe the discounted future stream of annual costs relating to each option.

Table 2 NGGT NPC Comparison between Different Options

Option	NPC to 2030	NPC to 2040	NPC to 2076
Tunnel 2012	£137m	£176m	£212m
Mitigate 2016	£131m	£182m	£305m
NPC comparison	Mitigate option is cheaper than the tunnel by £6m	Tunnel option is cheaper than mitigate by £6m	Tunnel option is cheaper by £93m

4.33. Our own Excel model published alongside this consultation, using what we consider to be more reasonable assumptions about various parameters, has produced the following results. We have modelled two scenarios. Scenario 1 uses our upper limits for probabilities and the lower limit for WACC in the future. Scenario 2 uses our lower limits for probabilities and upper limit for WACC in the future.

4.34. We have calculated NPCs to two time horizons, up to 2044 (the expected end of life of the current pipeline) and up to 2072 (the expected end of life of the proposed replacement).

Table 3 Ofgem NPC Comparison Between Different Scenarios

Option	NPC to 2044 (£m)		NPC to 2072 (£m)	
	Scenario 1	Scenario 2	Scenario 1	Scenario 2
Tunnel 2012 option	£60.89m	£88.65m	£74.56m	£108.42m
Mitigate option	£43.67m	£34.46m	£66.17m	£73.35
NPC comparison	The tunnel costs £17.22m more than mitigation	The tunnel costs £54.19m more than mitigation	The tunnel costs £8.39m more than mitigation	The tunnel costs £35.08m more than mitigation

4.35. When considering these results it is important to also recognise the uncertainty about the future need for Feeder 9. All of the CBAs assume with 100% certainty that the pipeline will be needed into the future. As stated in Chapter 2, we think there is a clear need for the Feeder 9 pipeline in the short term (i.e. until 2025), but there is some uncertainty about the need for Feeder 9 beyond this. If this risk that the pipeline is no longer needed were to be factored into the analysis then it would improve the case for the mitigation option.

The application of the HSE's ALARP test

4.36. The HSE's report to us states that it would not normally insist on the safety risk from continued mitigation being reduced as long as it is shown to be ALARP. The HSE has carried out its own modelling based on data provided by NGGT and concluded that the risk from continued mitigation would be ALARP if the net cost of

the tunnel option (taking account of the costs and benefits to consumers and NGGT) exceeds £5.11m (in 2009/10 prices).

4.37. Our analysis shows that, under a range of assumptions (high and low) and time horizons, the incremental cost of the tunnel option exceeds that threshold. Therefore, our initial view is that, the safety risk from continued operation of the pipeline is ALARP, and therefore does not need to be reduced further by replacement.

5. NGGT's decision-making process

Chapter Summary
In this chapter we describe and assess NGGT's decision-making process. We provide our initial views on whether NGGT's actions in relation to Feeder 9 are consistent with those of an efficient and economical operator.

Question box
Question 1: What are you views on our analysis of NGGT's decision-making process?

Context

5.1. As set out in Chapter 1, we included a reopener provision within the RIIO-T1 price control to allow NGGT to apply for funding for costs relating to Feeder 9. We included two reopener windows, one in May 2015 and the other in May 2018. We also said that the trigger for NGGT to apply for funding under the reopener mechanism was the granting of planning permission. Separately, we provided funding for preliminary engineering works and work required to apply for planning permission.

5.2. NGGT secured planning permission (through a DCO) for its preferred solution, i.e. a tunnelled replacement for Feeder 9, in August 2016. NGGT's internal management papers show that the final investment decision for building the tunnelled replacement was taken in April 2016. NGGT has commenced construction works and expects to complete the works and commission the new pipeline by 2021.

5.3. NGGT's request under this reopener now seeks retrospective funding for the tunnel project, which it has already commenced.

5.4. We do not consider that it is in consumers' interests to assess NGGT's submission starting with a presumption that the tunnelled replacement for the current Feeder 9 pipeline is the right solution for consumers. As with any significant investment project, we think it is necessary and appropriate to evaluate whether the proposed investment is the most efficient way of delivering the necessary transmission capacity. We also think it is generally in consumers' interests to keep the case for investment for large infrastructure projects under review for as long as reasonable, so that changes in circumstances or needs can be reflected in the final decision.

5.5. With this in mind, we have assessed NGGT's decision-making process to determine whether, in our view, it acted reasonably and in the interests of consumers when it decided to proceed with tunnel construction in 2016. As part of our assessment, we looked at whether it had properly considered alternatives

(including the ongoing mitigation approach) before deciding to commit expenditure on the tunnel.

Initial view

5.6. Our initial view is that NGGT does not appear to have given proper consideration to all available options at the time it decided to proceed with tunnel construction in 2016, and in particular, it did not seem to give adequate consideration to the option of continued operation of the current pipeline through a combination of regular inspections and mattressing (if needed).

5.7. NGGT's submission states that it had considered continued operation, but that it did not believe that continued operation on the current basis was a long-term solution. It believed, and continues to believe, that mattressing is a short-term and temporary solution that would not last for more than 5-10 years, and that pipeline replacement was the only viable long-term option.

5.8. Mattressing as a means of long-term pipeline protection has a long track record of being used under difficult conditions in a marine environment, particularly the North Sea, including in areas with strong tidal currents. It is routinely used to protect undersea gas pipelines and electricity cables. While the use of mattressing in a riverine or estuarine environment may be a relatively untested strategy, the history of its use in coastal and tidal marine environments suggest that mattressing can be used in areas with high water velocities and soil movement.

5.9. NGGT carried out its last round of mattressing works on Feeder 9 in 2010 (and on a small section in 2013). Since then it has been carrying out frequent river bed surveys. These surveys have consistently shown that the mitigation works have been successful, and that there are no areas requiring immediate attention. By the time the decision was taken in April 2016, NGGT had over three years of survey data that reached the same or similar conclusions.

5.10. NGGT has referred to a report produced by ABPmer in 2012 that states that the mattresses laid in 2010 are likely to last for 5-10 years. However, it is not clear to us whether NGGT's conclusion from this is that the mattresses that were laid in 2010 would only provide effective protection for 5-10 years (at which point further remediation may be required), or whether NGGT considers that mattressing as a protection strategy cannot be sustained for periods of time longer than 10 years.

5.11. Moreover, NGGT does not appear to have commissioned or reviewed updated technical reports in 2016 that looked at the condition of mattresses that were laid in previous rounds of mattressing (2010 and 2013). Given that these mattresses would have been in place for up to 5 years by then, it would seem reasonable at the time to test the hypothesis that the mattresses have a lifespan of 5-10 years.

5.12. Under the circumstances, we have not seen any evidence to suggest that frequent inspections coupled with mattressing when required is not a viable long-

term strategy for Feeder 9. We are open to considering any evidence provided in response to this consultation that suggests otherwise.

5.13. Moreover, NGGT did not carry out a full and comprehensive CBA of all options, including the option of continued mitigation, before making its final investment decision in April 2016. The EVA CBA provided to us as part of the reopener submission was carried out in mid-2017 (after the investment decision was made). We do not believe NGGT could have fully considered the existing risks to the pipeline and whether it was justified to proceed with the tunnelled replacement without a fully-developed CBA.

5.14. Since identifying the exposure of the pipeline in 2010, NGGT told us that it had not consulted the HSE to get its view on the safety risk to the pipeline and whether the current mitigation measures would be acceptable as a longer term solution. The HSE's framework for pipeline risk management requires NGGT (and other parties that have statutory obligations relating to health and safety) to undertake a CBA to ascertain whether a risk is ALARP before forming a view on whether that risk is acceptable. While NGGT has said that the risk from continued operation of the pipeline is not ALARP, we do not agree with this conclusion. The analysis that the HSE has carried out in support of our assessment concludes that the risk would be ALARP as long as the net cost of the tunnel (taking account of all costs and benefits) exceeds £5.11m. NGGT does not appear to have carried out an ALARP assessment when it decided to proceed with the tunnel.

5.15. NGGT obtained planning permission for the tunnel (through a DCO) in August 2016, four months after it took the final investment decision. We do not consider that obtaining planning permission itself is a good reason to proceed with the development – we would have expected NGGT to properly consider all options (including continued mitigation) before coming to a final decision.

5.16. One of the key benefits of the continued mitigation option is the "option value" that it offers. As long as there is some uncertainty about the future need for the Feeder 9 pipeline (as there is), there is some value to consumers from delaying an investment decision. The river bed surveys from 2015 and early 2016 indicated no imminent threat to the pipeline and that river bed levels had recovered or stabilised.

5.17. Based on the available evidence, we do not believe that NGGT's decision-making process gave adequate consideration to the option of extending the life of the current Feeder 9 through continued mitigation. This option was discarded early in the process for not being a long-term solution, even though there appears to be little or no rationale for limiting the choice to "long-term" solutions when a successful short-term solution was available, which could potentially be repeated whenever needed.

5.18. Our own CBA shows that, under a range of reasonable assumptions based on evidence that should have been available to NGGT at the time it took its decision (2016), the option of continued mitigation on Feeder 9 is favoured to the tunnel

option. Moreover, drawing on the HSE's analysis, our analysis suggests that the risks under the mitigation option are ALARP.

5.19. For these reasons, our initial view is that NGGT's 2016 decision to proceed with tunnel construction was not in the best interests of consumers at the time. We are not saying this with the benefit of hindsight, instead, we think that NGGT should have used the information available to it in 2016 to carry out a full assessment of whether replacement was the best option for consumers. Had it done so, we do not believe that the evidence before us now would have pointed towards the immediate replacement of the pipeline.

6. Assessment of efficient costs

Chapter Summary
This chapter sets out the results of our cost assessment. Were we to accept the needs case, our initial view is that we would consequently adjust allowances based on these costs.

Question box
Question 1: Do you have any views on our assessment of efficient costs? In particular, please provide your views on our approach to project management and risk contingency allowances.

6.1. As part of our assessment of NGGT's application for additional expenditure allowances to cover the cost of its preferred tunnel solution, we have considered the level of efficient costs under both NGGT's preferred option (i.e. the tunnel) and the continued mitigation option, which appears to us to be the more efficient option.

6.2. These costs would be relevant if, following consultation and consideration of any new evidence, we think it would be appropriate to provide funding for the tunnel project.

Efficient costs of continued mitigation on Feeder 9

6.3. We have estimated the costs that NGGT is likely to incur if it were to continue operating the current Feeder 9 through a combination of frequent inspections supported by mitigation in the form of concrete mattressing, where required.

6.4. Our estimates of these costs are based on NGGT's forecasts of the costs associated with:

- Regular inspections of the river bed and pipeline conditions.
- Regular inspection of the pipeline through pigging[48].
- Mitigation work in the event of pipeline exposure.
- Pipeline repair work in the event of a TPI.

6.5. The table below sets out our initial view of the efficient annual costs under this option.

[48] Pigging is the practice of using pipeline inspection gauges (PIGs) to carry out inspections and maintenance activities on pipelines.

Cost item	Our initial view of efficient annual costs (£m) 2009/10 prices
Annual operational costs (pipeline inspections, surveys, pigging)	£0.300m
Cost of emergency mattressing following pipeline exposure, adjusted for the probability of this being needed in any year	£0.424m
Cost of emergency mattressing following the development of a free span, adjusted for the probability of this being needed in any year	£0.076m
Cost of emergency repair work on the pipeline in the event of TPI, adjusted for the probability of this being needed in any year	£0.003m
Total cost of ongoing mitigation per year	**£0.803m**

Efficient costs of the tunnelled replacement for Feeder 9

6.6. Our assessment of the efficient costs of the tunnelled solution draws on NGGT's submission and responses provided to our supplementary questions. We have also received advice from external technical advisers and in-house technical resources.

6.7. NGGT's submission provides its view of the efficient costs of the tunnelled solution, i.e. £139.88m. We have particular concerns about NGGT's cost estimates in two broad areas. The first is its contingency or risk allowance and the second is its project management costs. Together, these make up a significant proportion ([percentage redacted due to commercial sensitivity]) of NGGT's total estimated project cost for the tunnel.

6.8. We discuss these cost areas in greater detail below

Risk allowance

6.9. NGGT's submission includes a risk allowance of [redacted due to commercial sensitivity], and NGGT has provided a detailed risk register to support this figure. The risk register included 91 different risks with an occurrence probability, maximum out-turn value, minimum out-turn value, a most likely value and a factored P50 value[49] for each risk.

[49] A P50 value is the value such that, given the probability of different out-turn costs, the

6.10. The risk allowance constitutes a significant proportion ([percentage redacted due to commercial sensitivity]) of NGGT's estimated project costs for Feeder 9. To further understand the risk allowance we requested that NGGT provides us with explanations of the mitigation measures it has taken, the profile of the risk, and how it has estimated the risk values.

6.11. NGGT told us that risk allowance is based on the factored P50 values for each risk, and that the factored P50 value is calculated in two ways:

- *Probability of occurrence * (1 x lowest cost + 4 x average cost + 1 x highest cost) / 6*
- *Probability of occurrence * (Average of minimum, most likely and maximum)*

6.12. Our initial view is that the probabilities used to estimate the factored P50 values often appear high. For instance, NGGT assumes a 10% probability that there would be a fire in the tunnel, and 60% probability that the construction site would be flooded.

6.13. The majority of NGGT's cost estimates are driven by an assumption about the cost of a delay which is set at [redacted due to commercial sensitivity] per day. We are not in a position to provide an alternative estimate; however, we do not think that this figure is justified given the lack of evidence provided to substantiate the figure and its criticality to estimating the risk allowance for a number of risks. We note:

- NGGT has used a flat rate for the daily cost of a delay for all years on the project regardless of level of activity or level of resource on the project. This does not seem reflective of the changing profile of work we would expect over the lifetime of the project:
- These costs are driven mainly by human resources since equipment costs are accounted in other risks separately. The estimate suggests a considerable level of human resources deployed on a daily basis across the project lifetime.

6.14. Our initial view is that NGGT's risk allowances are subject to insufficient consideration of mitigation options, high levels of uncertainties and somewhat arbitrary and subjective assumptions.

6.15. Given these concerns, we asked our technical advisers to review NGGT's risk register. Our advisers highlighted the lack of clarity in NGGT's risk assumptions and lack of justification for the various assumptions used. While acknowledging that producing an accurate risk allowance would require significantly more information, our advisers provided an indicative estimate that implied a total risk allowance of

actual out-turn cost is just as likely to exceed it as it is likely to fall below it. A factored P50 value is the P50 value multiplied by the probability that the risk materialises.

[redacted due to commercial sensitivity], which is significantly lower than NGGT's proposed [redacted due to commercial sensitivity].

6.16. We have considered an alternative top-down method of estimating a reasonable risk allowance. We think that a benchmark of 10% of total project costs is a reasonable figure to use based on our previous assessments of high value investment projects in the gas and electricity sectors. However, given the unique nature of this tunnel project, we would be willing to accept that this project carries a higher level of risk than a typical pipeline or cable project. Our initial view is that a 15% allowance for risks seems appropriate. Applying this benchmark results in a risk allowance of £15.7m. Our initial view is that we should use the top-down benchmark, unless additional information comes to light from consultation.

Project Management Costs

6.17. We note that there is no explicit budget line for project management costs in the submission made by NGGT for Feeder 9. Therefore, we have included costs of NGGT staff, NG Operations Staff, Project Services, Contractor's Project & Administration Staff and Principal Contractor Duties / Site Supervision within the overall cost category of project management costs.

6.18. Based on NGGT's cost figures, we estimate that project management costs constitute a significant proportion ([percentage redacted due to commercial sensitivity]) of the overall project costs. For other large infrastructure projects in the gas and electricity sectors, we have typically used a benchmark for project management costs of 15% or lower of total project costs.

6.19. To try and understand the reason for seemingly high project management costs in this project, we requested additional details, including a detailed breakdown of staffing structure and work allocation. However, the information provided in response did not provide sufficient information to justify the difference.

6.20. Furthermore, we have no reason to think that the tunnel project requires significantly more project management resource than other large electricity and gas infrastructure projects.

6.21. In light of this, our initial view is that we would apply our top-down benchmark for project management costs of 15% of total project costs, which is £15.7m.

Conclusion

6.22. Based on the information available to us, we give our initial view on the efficient costs of the project summarised below.

Cost category	NGGT request	Our initial view	Difference
Capital costs	Figures redacted due to commercial sensitivity		
Risk/contingency allowance			
Project management			
Total	£139.89m	£104.64	£35.24m

7. Our initial views

Chapter Summary

This chapter summarises our initial views on NGGT's application for additional allowances for replacing Feeder 9.

Question box
Question 1: Do you agree with our initial view to reject NGGT's application for funding for the replacement Feeder 9 pipeline?
Question 2: If we reject the needs case, do you have any views on the treatment of expenditure NGGT incurs on the tunnel for the purposes of the totex incentive mechanism (sharing factor)?

7.1. This chapter sets out our initial views on NGGT's application for additional funding to cover the costs of a new tunnelled replacement for the Feeder 9 pipeline.

7.2. As part of our assessment, we considered the following questions in the preceding chapters:

- Is the Feeder 9 pipeline needed?
- Has NGGT made the case for replacing the current Feeder 9 pipeline?
- Has NGGT demonstrated that a tunnelled replacement pipeline is the most efficient solution for consumers?
- Did NGGT acted economically and efficiently in deciding in 2016 to replace the current pipeline?
- What are the efficient costs of continued mitigation and the tunnelled replacement pipeline?

7.3. We discuss our initial views on each of these questions below.

Is the Feeder 9 pipeline needed?

7.4. The Easington area is the main route of entry to the UK for Norwegian gas. Feeder 9 transports gas from the Easington area to the rest of the NTS. Firm entry capacity bookings at the Easington terminal up to 2024/25 indicate that Feeder 9 is needed until then.

7.5. The longer term need for Feeder 9 depends on the extent to which the network in the Easington area is used in the future. While NGGT's FES modelling suggests that the pipeline could be needed beyond 2025 under several scenarios, these are not forecasts of the future.

7.6. The current Feeder 9 was commissioned in 1984, and has an expected lifespan of 60 years. This means that the pipeline would reach the end of its natural

life around 2044, providing an opportunity to review the need for the pipeline in the years leading up to 2044.

7.7. Our initial view is that, given the level of uncertainty around the future use of the network in the Easington area, it is quite possible that Feeder 9 is not needed at the end of its life (in 2044). Committing to a 60-year investment now (in the form of a tunnel) removes the option of decommissioning in 2044.

The case for replacement

7.8. NGGT's submission argues that there a number of risks from operating the current Feeder 9 pipeline and that these risks are high enough to warrant replacement.

7.9. The submission states that there is a risk of further river bed erosion around the Feeder 9 pipeline and this could lead to TPI or free spanning in extreme circumstances. NGGT has identified a number of adverse consequences that could arise from TPI or free spanning. These include safety concerns in the event of a TPI event involving a passing vessel, disruptions to gas supplies from the Easington terminal, which in turn could lead to higher gas prices for consumers and expose NGGT to significant constraint costs, shipping lane closures and damage to the local marine environment and wildlife.

7.10. We agree that operating the current Feeder 9 pipeline through continued mitigation entails some risk, and that this risk is likely to be higher than the risk associated with operating a tunnelled pipeline. However, as an efficient and economic network operator, we would expect NGGT to weigh these risks against the cost of building a tunnelled replacement pipeline, which customers would pay for through their gas bills.

7.11. We have consulted the HSE to seek its views on the safety risks from operating the current Feeder 9 pipeline. The HSE reviewed NGGT's submission and other supporting information, and concluded that NGGT's approach to managing the risk of free spanning on the current pipeline is adequate. On TPI, the HSE concluded that there is some risk, but that it would not insist on this risk be reduced as long as the net cost of this risk reduction (i.e. by building a tunnel) taking account of its benefits exceeds £5.11m (over a 60-year period).

7.12. NGGT's submission refers to the results of its own CBA, which states that the costs of continued operation exceed the cost of immediate replacement. We have reviewed NGGT's analysis and we disagree with certain key assumptions made by NGGT. Our own analysis suggests that, under a range of what we think are more plausible assumptions, the cost of replacement exceeds the cost of continued operation (including monetised risks). Moreover, our estimates of the net cost of the tunnel option (taking account of the costs and benefits of the tunnel to NGGT and consumers) exceeds the HSE threshold in both the high and low scenarios we have modelled.

7.13. NGGT has also identified a risk that it would no longer have the right through its lease to operate the Feeder 9 pipeline. If that were to happen, NGGT would have to consider building a replacement pipeline in order to maintain network capabilities. We are not convinced that this risk warrants pre-emptive replacement. In any case, we have taken account of the costs associated with this risk in our CBA.

7.14. By failing to take account of the "option value" offered by continued mitigation on the existing pipeline, we believe NGGT has overlooked a key benefit of that option relative to a tunnelled replacement. Given the uncertainty in the long term of the need for Feeder 9, it is possible that it will no longer be needed at some point in the future. By committing to a significant infrastructure investment with a 60-year life, NGGT would increase the possibility of creating a stranded asset – one that customers would continue to pay for long after it has ceased to provide any benefit to the gas transmission system and its users. It is difficult to quantify this benefit, and for this reason, we have not included this in our quantitative analysis. However, this only acts to strengthen the case for continued mitigation of the pipeline.

7.15. NGGT mentions the risk to the local marine environment and wildlife if the pipeline were to be damaged – mostly from the repair work that would be carried out as a consequence. However, we do not consider this to be a material consideration. NGGT's own analysis of the impact of mitigation works on the pipeline (submitted to the MMO) is that the risk to the environment and wildlife is not significant.

7.16. Taking all of these factors into account, our initial view is that the case for replacing the current Feeder 9 has not been made. Our review and analysis based on information provided to us by NGGT indicates that the option of continued operation of the current pipeline delivers better value for consumers.

NGGT's decision in 2016 to proceed with tunnel construction

7.17. NGGT took the decision to proceed with tunnel construction in 2016, ahead of this reopener process. NGGT has commenced construction and has already committed significant amounts of expenditure on the project (£93m by the time of submission of the reopener application). We do not consider it is in consumers' interests to assess NGGT's 2018 application starting with a presumption that a replacement pipeline through a tunnel is the most efficient option for consumers.

7.18. At the start of RIIO-T1 in 2012, we accepted NGGT's proposals to carry out preliminary engineering assessments on the tunnel project and to apply for planning permission. However, we recognised the uncertainty around when the tunnel may need to be built and what it may cost. Given this uncertainty, we included a reopener mechanism in the RIIO-T1 price control, and said that NGGT could apply for appropriate funding after planning permission is granted. Critically, we did not commit to funding any particular solution through the reopener.

7.19. NGGT considers that we accepted the needs case in 2012; we disagree. In any event and irrespective of what NGGT may have considered to be the right solution in

the period leading up to the start of the RIIO-T1 price control in 2012, we think a reasonable company acting efficiently would have carried out a full assessment of available options. It would have compared the costs and benefits of each option before committing to a large capital-intensive infrastructure project.

7.20. Our initial view is that NGGT does not appear to have carried out a thorough assessment of its options before committing to the tunnel project. It also did not appear to give adequate consideration to the option of continued operation of the current pipeline through a combination of regular inspections and mattressing (if needed).

7.21. NGGT has said that mattressing is a temporary solution lasting 5-10 years, and that a different solution is needed. Mattressing is a widely used underwater protection method, and is used extensively in the North Sea under challenging conditions. NGGT's previous use of mattressing has been successful, and it appears that NGGT has done little to demonstrate its theory that mattressing is temporary or that it would only last for 5-10 years.

7.22. Since NGGT carried out its last round of mattressing in 2010 and in 2013, river bed surveys have consistently shown that there are no areas requiring immediate attention. By the time the decision was taken in April 2016, NGGT had over three years of survey data that reached the same or similar conclusions.

7.23. NGGT did not carry out a full CBA covering a range of reasonable options, including the option of continued mitigation, before making its final investment decision. NGGT's CBA was carried out in mid-2017 (after the investment decision was made, and expenditure on the tunnel had begun to be incurred). We do not believe NGGT could have fully considered the existing risks to the pipeline and whether it was justified to proceed with the tunnelled replacement without a fully-developed CBA.

7.24. While NGGT obtained a DCO for the tunnel in 2016, we do not consider that obtaining development consent itself is a good reason to proceed with the tunnel – we would have expected NGGT to properly consider all options (including continued mitigation) before coming to a final decision.

7.25. Based on the available evidence, we do not believe that NGGT's decision-making process gave adequate consideration to the option of extending the life of the current Feeder 9 through continued mitigation. This option was discarded early in the process for not being a long-term solution, even though there appears to be little or no rationale for limiting the choice to "long-term" solutions when a successful short-term solution was available, and could potentially be repeated whenever needed.

7.26. Our initial view, based on information provided to us, is that NGGT's actions leading up to the decision in 2016 to proceed with tunnel construction do not appear consistent with those of an economic and efficient operator. We have noted a

number of gaps in NGGT's decision-making process that meant that its decision is unlikely to have been made based on complete analysis or information.

Our initial view of efficient costs

7.27. As part of our assessment of NGGT's application, we have considered the level of efficient costs under both the continued mitigation option and the option of a tunnelled replacement.

7.28. Our initial view of the efficient costs of the continued mitigation option is £0.803m per year. This includes £0.3m for regular pipeline inspections and surveys, and £0.503m for emergency mattressing or repairs, taking account of the probability that this work would be needed in any year.

7.29. Our initial view of the efficient costs of the replacement pipeline through the tunnel are £104.642m. NGGT has requested funding of £139.883m for the tunnel. We have made reductions to NGGT's requested costs, mainly to project management costs and contingency risk allowances which we did not think were justified.

Our proposals

7.30. Following our assessment, and for the reasons stated earlier, our initial view is that NGGT has not made the case that an adjustment to its baseline allowances for the cost of replacing Feeder 9 is warranted.

7.31. We note that NGGT has already commenced tunnel construction and has committed significant amounts of expenditure to the project (approx. £93m). However, our initial view is that this decision by NGGT was not supported by reasonable and proportionate analysis based on information that was, or should have been, known to NGGT at the time. In our view, the decision was not consistent with the actions of an efficient and economic operator.

7.32. However, we recognise that continued operation of the current pipeline carries some risk for NGGT and consumers, and there is uncertainty about the probabilities of events that only occur very rarely. Whereas our initial view, based on the information provided to us by NGGT and received from the HSE and our advisers, is that continued mitigation is the most economic and efficient solution for consumers, we are open to considering any new information about the costs and risks under the different options before we reach our final decision in September 2018. We encourage stakeholders to review our analysis, and the analysis carried out by NGGT, and provide their views by responding to this consultation.

7.33. Our initial view of efficient costs of the mitigation option is £0.803m per year, or £6.424m over the entire RIIO-T1 price control period.

7.34. The specific reopener cost category (One-off Asset Health Costs) that NGGT has applied under has a materiality threshold of £28.912m. This means that an adjustment to allowances under this category can be made only if it exceeds £28.912m. Consequently, we do not propose to make any adjustments to NGGT's allowance as part of this reopener.

7.35. In our RIIO-T1 Final Proposals, we said that "*if costs have not reached, or are not forecast to reach, the materiality threshold by the second reopener window we will assess additional costs as part of the next price control review*"[50]. In line with this statement, we will consider providing an allowance for efficient costs incurred in the RIIO-T1 period for operating the current pipeline as part of the RIIO-T2 price control. For the avoidance of doubt, this does not imply that this process will provide funding for costs incurred during the RIIO-T1 period for building the tunnel.

7.36. Although this is not directly within the scope of the 2018 reopener process, we would like to provide some clarity on the treatment of any expenditure incurred by NGGT on the tunnel for the purposes of implementing the Totex Incentive Mechanism or sharing factor.[51] Even if we rejected NGGT's application for funding as part of this reopener, NGGT has already incurred some expenditure on the tunnel (and may continue to do so afterwards). Unless we decide otherwise, NGGT would only bear 44.36% of the cost of this expenditure – the rest would be borne by consumers now and in the future.

7.37. In our RIIO Handbook, we said "*we reserve the option, in exceptional circumstances, to make an adjustment to over-ride the mechanistic sharing of actual expenditure through the efficiency incentive rate. For example, if we can demonstrate that a network company has wasted money we may need to make an adjustment to prevent consumers from bearing a proportion of that waste*"[52]. We reiterated this in our RIIO-T1 Final Proposals, by saying that "*Ofgem reserves the option to disallow costs from the RAV if they do not relate to the regulated business or are demonstrably inefficient or wasteful*"[53].

7.38. While our initial view is that NGGT's decision to proceed with the tunnel is not supported by a robust needs case, and therefore not consistent with how we would expect an economic and efficient operator to act, we have not yet formed a view on whether that inefficiency on NGGT's part is sufficiently serious to be considered for disallowance from the sharing factor. Moreover, the RIIO Handbook states that we would only consider disallowance of expenditure in "exceptional" circumstances. We

[50] pg 19, RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas (Cost assessment and uncertainty Supporting Document)
[51] Within the RIIO framework, any over or under spends by a company against its allowances are shared between the company and customers based on a pre-determined sharing factor. For NGGT, the sharing factor is 44.36%, which means that NGGT would bear 44.36% of any overspends and customers bear the rest.
[52] pg 88, Handbook for implementing the RIIO model
[53] pg 76, RIIO-T1: Final Proposals for National Grid Electricity Transmission and National Grid Gas

welcome stakeholders' views on whether any expenditure on the tunnel should be disallowed from the sharing factor.

7.39. If we were to confirm our initial views on the need for the tunnelled replacement in our final decision, we would set out our decision on the treatment of actual expenditure on the tunnel along with any relevant next steps.

Next steps

7.40. This consultation will close on 29 August 2018. Please send in your response by emailing us at gasnetworks@ofgem.gov.uk.

7.41. In proceeding with a 21-day consultation we welcome engagement from interested stakeholders during the consultation period. The shorter period is driven by the licence requirement to determine any relevant adjustments to NGGT's allowed expenditure by the end of September and the time we need to consider responses to consultation, engage with interested stakeholders and revise our analysis, if necessary.

7.42. Our decision will be implemented through the 2018 Annual Iteration Process, which means that any adjustment to NGGT's allowed revenues would take effect from 2019/20.

Appendix 1 - Feedback on this consultation

How to respond

1.1 We want to hear from anyone interested in this consultation. Please send your response to the person or team named on this document's front page.

1.2 We've asked for your feedback in each of the questions throughout. Please respond to each one as fully as you can.

1.3 We will publish non-confidential responses on our website at www.ofgem.gov.uk/consultations, and put it in our library.

Your response, data, and confidentiality

1.4 You can ask us to keep your response, or parts of your response, confidential. We'll respect this, subject to obligations to disclose information, for example, under the Freedom of Information Act 2000, the Environmental Information Regulations 2004, statutory directions, court orders, government regulations or where you give us explicit permission to disclose. If you do want us to keep your response confidential, please clearly mark this on your response and explain why.

1.5 If you wish us to keep part of your response confidential, please clearly mark those parts of your response that you *do* wish to be kept confidential and those that you *do not* wish to be kept confidential. Please put the confidential material in a separate appendix to your response. If necessary, we'll get in touch with you to discuss which parts of the information in your response should be kept confidential, and which can be published. We might ask for reasons why.

1.6 If the information you give in your response contains personal data under the General Data Protection Regulations 2016/379 (GDPR) and domestic legislation on data protection, the Gas and Electricity Markets Authority will be the data controller for the purposes of GDPR. Ofgem uses the information in responses in performing its statutory functions and in accordance with section 105 of the Utilities Act 2000. Please refer to our Privacy Notice on consultations.

1.7 If you wish to respond confidentially, we'll keep your response itself confidential, but we will publish the number (but not the names) of confidential responses we receive. We won't link responses to respondents if we publish a summary of responses, and we will evaluate each response on its own merits without undermining your right to confidentiality.

Appendix 2 – Review of Feeder 9 probability estimates

This appendix sets out the results of a review into the probability estimates used by NGGT in its CBA and the alternative estimates used in our version of the CBA. This review was carried out by the Chief Engineer at Ofgem.

Review of Feeder 9 probability estimates

A number of probability ranges have been developed for use in Ofgem's cost benefit assessment of the proposed Feeder 9 gas pipeline replacement. These relate to the probability of a scour event occurring that erodes the floor of the Humber Estuary and impacts on the integrity of the existing pipeline, and the potential for free spanning to develop that requires the pipeline to be shut down while remediation is undertaken or the pipeline replaced. These have been developed using a high level view provided by our technical advisers.

I have reviewed the proposed probability ranges and offer the following comments:

Probability of a scour event occurring in any one year

NG view 0.35, Ofgem View 0.058 – 0.2

Two scour events affecting the pipeline have been detected during its 34 year life:

- first in 2009/10 resulting in the 104m of pipeline being exposed, which was remediated with the installation of concrete frond mattresses and gravel bags covering ~ 760m of the pipeline;
- second in 2012, where 50m of the fond mattresses experienced scour and were considered at risk of being undermined, which was remediated by overlaying the section with 90 additional fond mattresses in 2013.

Reported monitoring suggests these are discrete environmental events rather than a cumulative process of erosion, and the same conclusion can be drawn from events reported for Feeder 1.

I would consider the probability of a further event impacting the pipeline in any given year to be less than the 2 years in 34 so far experienced – i.e. < 0.058, given that:

- robust protection measures are now in place;
- the pipeline is now covered across its entire length that lies below the navigation channel;
- the pipeline and mattresses are subject to ongoing inspection;
- there have been no reported scouring events impacting the pipeline since the remediation of 2013; and
- further remediation will be undertaken where failures in the protection measures are identified.

I would therefore regard the lower bound of 0.058 used in Ofgem's CBA to be overly pessimistic.

The upper bound probability of a scour event impacting the pipeline has been derived as 0.2, based on the minimum expected life of the mattresses (i.e. 5 – 10 years). This assumes that a subsequent scour event impacting the pipeline will occur following failure of the mattresses, which is again pessimistic given that only two scouring events have been detected in the last 34 years.

I would consider the upper bound of 0.2 used in the Ofgem CBA as only credible where regular inspections fail to identify scour and/or mattress degradation and no remedial action is taken – i.e. NGGT are negligent in their duties. Given the history and criticality of this pipeline, I would expect NGGT to continue their close monitoring so that the upper bound risk of scouring doesn't ever materialise.

Overall, I consider the lower bound probability of 0.058 of a scour event impacting the pipeline to be overly pessimistic, let alone the upper figure of 0.2 or the 0.35 suggested by National Grid.

Probability that a scour event then leads to a free span of < 20m:

NG view 0.35, Ofgem View 0.1

NGGT's implied 0.35 probability of a scouring event leading to < 20 m of free span is in my view overstated, particularly given that the initial exposure of > 100m of pipeline in 2009 didn't lead to any free spanning. Free spanning results from a scouring event that takes away the seabed which undermines the pipeline, which is a serious event and much less likely to occur than the relatively minor scouring events so far witnessed. This might only occur if the current protection were to catastrophically fail and not promptly rectified. The likelihood of the current protection failing in a given year which goes undetected long enough for a free span to develop as a result of scouring is small, particularly given the experience NGGT now have in monitoring and protecting this pipeline.

I suggest that Ofgem's proposed 0.1 probability of a free span developing from a scouring event due to a failure occurring and going undetected / unresolved is overly pessimistic, given the stability of the protection since 2013 and the bi-monthly inspection regime in place. Any erosion detected would likely be picked up and promptly remediated before any free spans could develop.

However, as the average age of the protection measures increase, so the probability of failure occurring between inspections could also increase, which could in theory go undetected long enough for a free span to develop. With this in mind, the suggested figure of 0.1 seems a reasonable maximum to apply, albeit very cautious.

Probability that a scour event then leads to a free span between 20m and 55m:

NG view 0.068, Ofgem View 0.02

The hypothesis assumes these would be formed from a smaller span occurring and remediated at a probability of 0.1 (from above), and subsequently failing at a probability of 0.2 based on a minimum life of 5 years of the mattresses, and then developing into a larger span with high probability. This 20% probability of a subsequent failure seems high given the success of the additional protection installed in 2013. Also, the automatic assumption that this failure would then develop into a larger free span seems very pessimistic. I suggest the more likely scenario is that two small free spans develop simultaneously and go undetected, (probability 0.1 x 0.1 = 0.01), which would be further reduced when considering the probability of these joining together into a larger span.

Probability that a scour event then leads to a free span > 55m:

NG view 0.00511, Ofgem View 0.004

The hypothesis assumes these would be formed from a larger free span occurring and remediated at a probability of 0.02 (from above), and subsequently failing at a probability of 0.2 based on a minimum life of 5 years of the mattresses, and then developing into a very larger span with high probability. Again, the 0.2 probability of a subsequent failure seems high given the success of the additional protection installed in 2013, and the automatic assumption that this failure would subsequently develop into an even larger span is very pessimistic. It is however broadly consistent with those proposed by National Grid.

Conclusion

I consider the logic used in deriving probability ranges for the CBA applied to be reasonable, although the analysis is overly pessimistic, particularly for the development of larger free spans that would risk damaging the integrity of the pipeline. It is conceivable that that a scouring event could lead to a small free span developing if the current protection measures fail, particularly along the ~25m length where cover is < 1.8m. Less credible is that if this is remediated with further protection, then subsequent failure is more likely to happen and would lead to a larger free span developing. Instead I would expect remediation with close monitoring thereafter to reduce the risk of subsequent failure.

Given that very few scouring events and mattress failures have been reported, there is limited data to support a robust statistical analysis. The probability ranges cannot be regarded as statistically sound with such a small data sample. Also, there remains uncertainty over the long-term performance of the current protection measures. So while I believe the range of probabilities proposed to be overly pessimistic, it would be reasonable to use these cautious figures in the CBA to cover any upside uncertainty that remains.

Chief Engineer, Ofgem
2 August 2018