Northern Gas Networks

A22.c - Offtakes and PRS Pressure Control

Engineering Justification Paper

Contents

1. Summary table

Name of Project	*Offtake and Pressure Reduction Sites – Pressure Control RIIO-GD3*		
Scheme Reference	*A22.c.NGN*		
Primary Investment Driver	*Asset Health/Obsolescence/Compliance/Capacity*		
Project Initiation Year	*2026/27*		
Project Close Out Year	*2030/31*		
Total Installed Cost Estimate (£)	*£23.28m*		
Cost Estimate Accuracy (%)	*+/-5%*		
Project Spend to date (£)	*£0*		
Current Project Stage Gate	*Specific delivery identification*		
Reporting Table Ref	*5.01 LTS, Storage & Entry*		
Outputs included in RIIO-GD3 Business Plan	*As per BDPT above, impact of programme in NARM BPDT*		
Spend Apportionment	**RIIO-GD2**	**RIIO-GD3**	**RIIO-GD4***
	£22.97m	*£23.28m*	*c.£12-13m*

* Expecting all investments listed for RIIO-GD3 to complete in RIIO-GD3. RIIO-GD4 spend is based on indicative asset health spend in RIIO-GD3.

2. Executive summary

This Engineering Justification Paper (EJP) sets out the interventions that we plan to undertake on pressure control assets across our Offtake and Pressure Reduction Stations (PRSs) during RIIO-GD3. Our preferred option is to carry out 139 individual interventions at a cost of £23.28m throughout RIIO-GD3 across our pressure control assets. This consists of:

- 5 Non volumetric full system replacements
- 10 Non-volumetric partial system replacements (equivalent to 40 units)
- 15 regulator overhauls
- 100 lineguard cabinets (refurbishments)
- 2 volumetric full system replacements
- 3 capacity upgrades

We also modelled a 'Do More' option by increasing the volume of interventions by 20% to be more proactive in this space, or 'Do Less' by reducing interventions by 20% to allow our assets to age for longer before we intervene. A summary of these options is provided below.

Options	Number of Interventions	Total RIIO-3 Cost (£m)
Preferred Option	139	23.28
Do More Option	166	26.18
Do Less Option	112	19.98

Table 1 Options summary

Costs for Pressure Control for the RIIO-GD3 EJP (£23.28m) are comparable to projected RIIO-GD2 spend (£22.97m) on a comparable 23/24 price basis, as shown below. We are planning to undertake more interventions in RIIO-GD3 than in RIIO-GD2, largely due to the 100 lineguard cabinet refurbishments that planned.

	RIIO-GD2		RIIO-GD3 EJP Preferred Option	
Asset	Workload units	Capex (£m) 23/24 prices	Workload units	Capex (£m) 23/24 prices
Pressure Control	57	22.97	139	23.28

Table 2 RIIO-GD2 vs RIIO-GD3 investment

We are continuing to see increasing deterioration in asset health with some assets approaching end of life resulting in a shift from a predominately refurbishment focus in RIIO-GD2 to replacement focus in RIIO-GD3. A Lineguard Cabinet programme has also been proposed in RIIO-GD3 due to reasons of obsolescence and to maintain compliance (£6.2m). Finally, also of note, 3 Capacity upgrades with associated pipework have also been identified as required in RIIO-GD3 to preserve the capacity of the network (£4.8m). Further details on each of these investments are given in the body of the report.

We view our preferred option as balanced programme required to deliver investments to combat asset health, obsolescence, capacity and compliance issues: maintaining a safe, reliable, compliant network of assets for our customers whilst minimising costs for customers. The investments listed above in our preferred scenario and detailed further in the body of the EJP will enable for us to continue to meet our licence obligations over the course of RIIO-GD3.

3. Introduction

This Engineering Justification paper details our proposals for investment on our Offtake and PRS pressure control assets during RIIO-GD3 and acts as a narrative to be used in conjunction with the accompanying Cost Benefit Analysis (CBA). It explicitly follows Ofgem's guidance and is set out in accordance with the headings therein.

Our Offtake and PRS assets are a critical part of our gas transportation service and require ongoing maintenance, repair, refurbishment and replacement to ensure we manage increasing risks associated with asset health. During RIIO-GD2 we have implemented a more robust maintenance and refurbishment strategy to extend asset life and ensure our gas transportation service continues to function safely and reliably whilst representing value for our customers. This strategy will continue throughout RIIO-GD3, however, there are also compliance and supplier requirements which will require the replacement of mechanical assets such as water bath heaters, odorant, pressure control assets and metering systems.

Failure to maintain our pressure control assets risks non-compliance with the Pressure Systems Safety Regulations (PSSR) which is mandated by the Health and Safety Executive (HSE). The aim of these Regulations is to prevent serious injury from the hazard of stored energy as a result of the failure of a pressure system, or one of its component parts. Were we to allow our pressure control assets to degrade, we would increase our risk of noncompliance with this legislation which is vital to protect the health and safety of our workforce and the wider public. We do not constitute this risk to be acceptable and therefore have developed a programme of work to ensure the continued safe operation of these assets.

Interventions in this area are asset health driven, as it is imperative that slam shuts and regulators remain in good condition in order to ensure gas continues to flow through our network in a safe and reliable manner. The key driver for pressure control interventions is our concern over aging assets (specifically the Audco Lineguard system) and the increasing obsolescence of those systems. It is becoming increasingly difficult to source the required replacements, as well as to access the specialist knowledge required for these systems, which poses a risk to our ability to pro-actively maintain the health of these assets. We must be pro-active in replacing these assets with modernised alternatives if we are to continue to manage risk down to an acceptable level. There are also a number of capacity investments we will need to make over the course of RIIP-GD3 to ensure continued reliability of our network.

This EJP aims to outline the justification for our proposed RIIO-GD3 Offtake and PRS pressure control investment, detailing our asset management decision-making process during which we analyse risk and value and trade-off between different intervention options. It explains the drivers for investment, the inputs and assumptions used in our CBA and how our proposed investment benefits our customers and stakeholders.

We have used a combination of our Value Framework and our asset data and expertise to determine the appropriate interventions during RIIO-GD3. Our preferred option for RIIO-GD3 is set out in the Table 3 detailing the driver for investment.

Our preferred option will have a positive risk reduction impact; however we will still see risk increasing by 15% from start of RIIO-GD3 levels, all risk categories apart from carbon do however meet our maintain risk objective. One of our key customer impact measures is supply interruptions and we expect a 3% reduction from start of GD3 levels under our preferred option. The investment programme pays back within 15 years and ensures we can continue to meet our compliance requirements. (See Table 15).

The profile of the workload across the price control period is shown in more detail in Section 10.4 and the Spend profile is detailed in Section 10.2. Unit costs used within the cost benefit analysis have been fully detailed within Section 8.6.

	RIIO-3 EJP Preferred Option		
Intervention	**Workload units**	**Capex (£m) 23/24 prices**	**Driver**
Non volumetric - Full system replacement	5	5.24	Asset Health
Non-volumetric partial system replacement - per system (equal to 4 units)	10	2.02	Asset Health
Regulator overhauls (don't fall under NARM)	15	1.05	Asset Health
Lineguard Cabinets	100	6.20	Obsolescence/ Compliance
Volumetric - Replacement	2	4.00	Asset Health
Capacity Upgrades - Regulator	3	3.17	Capacity
Capacity Upgrades - Inlet/Outlet Pipework	4	1.60	Capcaity
Total	**139**	**23.28**	

Table 3 RIIO-GD3 workload, cost and driver

4. Equipment summary

Pressure Control is the main system/assets on any NGN Offtake or PRS site. Pressure control is used at these sites to reduce the pressure of gas using regulators as it moves from rural to more developed areas and where a lower pressure is required to supply properties. The pressure control system also has built in safety systems, called slamshuts, that would, in a result of asset failure, stop the flow of gas downstream and protect the system from over-pressurisation.

These systems are governed by the specification NGN/SP/TD/13 Ed3 and are subject to Pressure Safety System Regulations (PSSR)[1] regulations.

Pressure control assets can be split up into two main types, these are;

- Volumetric control – This type of control is limited to the largest Offtake sites and controls the flow of gas. NGN own and operate 12 of these sites/systems.
- Pressure control – This type of control is the main type on the medium and small offtakes and PRS sites. This type of control works based on demand and gas is pulled through the system based on end user demand.

The general set up of a pressure control system on a high-pressure site is as follows and is designed to provide a flow of gas at constant pressure into a downstream system;

2 parallel streams or more comprising the following assets. At least one stream will normally be denoted as a standby stream as a precaution against failure of another, thereby ensuring redundancy:

- Stream Inlet and Outlet Isolation valve
- Slamshut valve (Generally including a lineguard system) – a safety device to protect against downstream over pressurisation.
- Monitor Regulator
- Active Regulator
- Pilot control system
- Relief vents and valves

[1] https://www.hse.gov.uk/pressure-systems/pssr.htm

There are ancillary assets that are associated with pressure control equipment but not necessarily affected/impacted as a result and aren't included in this EJP, these are;

- Instrumentation
- Telemetry
- Pipework

There are currently 207 slam shut and regulator systems installed across the network. The diagram below shows the number of systems according to diameter in inches.

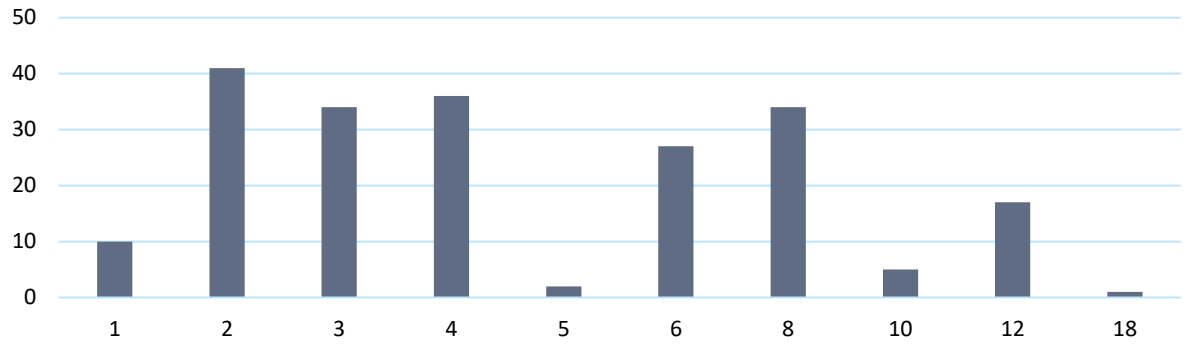

Figure 1 number of slam shuts and regulators by diameter (inches)

The different types of interventions considered for Pressure Control Systems, with examples, are detailed in Section 8.

The change in Asset Health (Health Index) over RIIO-GD3 with and without investment is shown in Section 5.

5. Problem / opportunity statement

Audco Lineguard System

On all pressure reduction sites where inlet pressures exceed 2.0Bar, there is a requirement under the (PSSR) to protect outlet pipework from exceeding its Safe Operating Limits (SOL), Industry standard TD13 requires the use a Slam Shut safety device.

NGN operates 146 PRS and 23 OT sites, with a majority (139) utilizing the Audco Lineguard System as their slam-shut safety device. This system was a popular choice within NGN's network during the late 1970s to early 1980s. While the original equipment manufacturer (OEM) has discontinued support for Audco Lineguard since the 1990s, individual components can still be maintained, albeit with limited availability of overhaul spares.

Figure 2 photograph showing lineguard system

The Audco Lineguard system incorporates a rough cut function that allows the slam-shut valves to automatically reopen as downstream pressure decreases. However, if a fault persists on both supply streams, this can lead to an indefinite slam/open, slam/open cycle. This scenario effectively maintains outlet pressure and supply until technicians can arrive on-site to investigate and address the underlying issue.

[redacted]

During remedial works and routine maintenance, the advanced age of the assets has become increasingly apparent, with signs of deterioration evident in cabinets, pipework, and non-compliant copper piping. To assess the condition of individual components and determine the most appropriate course of action, a third party report was commissioned. This report provided recommendations for repair or replacement based on factors such as cost, OEM obsolescence, and spare parts availability.

Given the obsolescence and reliability concerns, a phased replacement of the Audco Lineguard system with modern, supported alternatives has been recommended. This would ensure continued compliance with PSSR and reduce the risk of incidents.

It is imperative that slam shuts and regulators remain in good condition in order to ensure gas continues to flow through our network in a safe and reliable manner. There are a number of key interventions we are considering in our investment options detailed in Section 8.

Regulator overhaul interventions are being driven by asset health, deteriorating assets. This intervention as in RIIO-GD2 is being applied where we can act to improve the asset and improve its longevity. Where this has not been possible, replacements have been considered.

Volumetric full system replacements are being driven by asset health (condition). Non-volumetric replacements and partial replacements are also in the main being driven by asset health (condition), although we are seeing some instances of lack of control on non-volumetric systems where control systems are not operating as they should resulting in increased faults and indicating intervention.

Capacity constraint investments have been considered where we have sites already exceeding capacity limits, or narrowly approaching them (97%). All of our options in Section 8 include 3 capacity investments, 2 on offtakes and 1 on a PRS, as we view these to be critical must do investments to ensure the capacity of the network.

Why are we doing this work and what happens if we do nothing?

NGN's Value Framework

We have developed a Value Framework which we use to assess the value of intervention options consistently across asset classes for CBA and business planning purposes. We use the NARM methodology as the basis of our Value Framework and are consistent with the Consequence Measures. However, we have recategorized them into five risk groups, not four, so that there is clear distinction between NGN and societal costs and benefits and so that the present values being calculated are correct. This is further explained in our Network Asset Management Strategy. The five risk groups within our Value Framework are: Customer Risk, Health & Safety Risk, Environmental Risk, Compliance Risk and Financial Risk.

To derive a monetary value for the Cost of Consequence each Consequence Measure is allocated a monetary value which is multiplied by the quantity of the consequence. The monetary values used within our Value Framework are based on the agreed NARM assumptions and uses values common across GDN's such as the base price year, industry approved values such as the cost of carbon or the social cost of an injury. In addition, we use values specific to our business such as the cost of maintenance or the cost of loss of supply. The quantities used are specific to our network such as the number of domestic properties at risk of a supply interruption and have been derived from system data, network analysis or assumptions based on demands, flow and redundancy.

When justifying our RIIO-GD3 capital programme the monetary value of each Consequence Measure is calculated to determine the benefit or avoided cost of an intervention. Examples include:

- **Customer Risk** – Avoided GDN costs through a reduction in costs of supply incidents (loss of supply). These costs have been calculated from historic incidents and the probability and scale of the incidents are based on NARM models.
- **Health & Safety Risk** – Societal benefits in avoided costs through reductions in the probability of fatality or non-fatality injury. These costs are in accordance with the NARM methodology.
- **Environmental Risk** – Societal benefits in avoided costs through reductions in the volume of carbon emitted when gas is leaked or consumed. These costs are in accordance with the NARM methodology and industry approved values.
- **Compliance Risk** – Avoided GDN costs through a reduction in costs of fines and paying for explosion damage. These costs are in accordance with the NARM methodology. They have been separated from direct Financial Risk as we consider them highly uncertain and likely significantly underestimated by the values in NARM, which does not consider reputation, legal and handling costs.
- **Financial Risk** – Avoided GDN costs through reductions in the costs to fix assets on failure and the direct financial cost of the gas leaked from and consumed by our assets. These costs are in accordance with the NARM methodology.

OT PRS Risk Profile (start RIIO-GD3)	Compliance Risk £m	Customer Risk £m	Environmental Risk £m	Financial Risk £m	Health & Safety Risk £m	Total Risk £m	%
Preheating (excl Low Nox)	1.59	3.48	0.78	0.27	0.59	**6.71**	14%
Preheating (Low Nox)	0.19	0.95	0.14	0.04	0.07	**1.40**	3%
Filters	3.31	0.01	7.68	1.29	1.22	**13.51**	28%
Pressure Control	3.92	0.07	12.28	2.14	1.44	**19.85**	42%
Odorant & Metering	1.29	2.89	0.00	1.70	0.43	**6.31**	13%
Total	**10.30**	**7.39**	**20.89**	**5.44**	**3.75**	**47.78**	

Table 4 Offtake and PRS risk profile at start of RIIO-GD3

As can be seen in Table 4, pressure control assets account for the highest risk proportion on Offtakes and PRS at the start of RIIO-GD3, at 42%. The predominant risk is environmental risk, but compliance risk is also significant contributors to total risk.

As highlighted earlier, it is becoming increasingly difficult for us to source replacement parts for our slamshuts and regulators due to their age and increasing obsolescence. Our risk of failure across these is increasing and our analysis has demonstrated that without any intervention in RIIO-GD3, risk increases significantly.

Due to the complexity of some of our assets, failure could result from a magnitude of different circumstances. As an example, failure in pressure control leading to low/high outlet pressures may result from failure of the regulators to control, potentially due to the soft parts perishing, failure of the pilot regulators or a complete failure of the regulator, failing either in the open or the closed position. This would lead to the primary protective device, the slam shut valve functioning which would stop gas supply and result in a loss of supply event, if the slam shut valve failed to function it would result in high outlet pressure which increases the risk of an explosion in the downstream network.

Without intervention, over the course of RIIO-GD3 risk increases predominantly due to deterioration of the assets but also due to other effects such as the rising cost of carbon. Table 5 below shows that without intervention, pressure control assets at our offtake and PRSs would increase by 20% over the course of RIIO-GD3.

OT PRS Risk Change over RIIO-GD3 w/o intervention	%
Preheating (excl Low Nox)	17%
Preheating (Low Nox)	21%
Filters	13%
Pressure Control	20%
Odorant & Metering	28%
Total	**19%**

Table 5 Offtake and PRS Risk change over RIIO-GD3 without intervention

Our Decision Support Software allows us to understand various service measures associated with each asset and how these change over time with and without investment. For our Offtake and PRS assets the key service

measure is the Total Expected number of Supply Interruptions (SI). Without intervention, we would expect an increase of supply interruptions relating to pressure control assets of 1% on Offtake and PRS as shown in Table 6.

OT PRS Service Level Change over RIIO-GD3 w/o intervention	%
Preheating (excl Low Nox)	
Preheating (Low Nox)	7.3%
Filters	8.5%
Pressure Control	0.6%
Odorant & Metering	24.2%
Total	**9.9%**

Table 6 Offtake and PRS service level change over RIIO-GD3 without intervention

These assets form a critical part of our transportation service and asset failure may affect tens or hundreds of thousands of customers. This would be a catastrophic loss of supply event resulting in customers off gas for a considerable length of time.

Consideration of Pressure Control Asset Health

We have utilised the NARM Value Framework in order to assess the health of our assets. We are however using the latest NGN asset data rather than the NARM data which is held in time as at the start of RIIO-GD2 for regulatory reporting purposes.

Offtake and PRS assets are assigned a Health Banding 1-10 based entirely on the total failure rate (i.e. the sum of all failure rate components). There are ranges of failure rates which assign an asset to bands 1-10. For pressure control, if the asset has less than 0.05 total failure rate (expected number of failures per year), is it in band 1, but greater than 0.45 then it is in band 10.

Consideration of preheating health trends is useful in the calculation of asset risk. Table 7 highlights the health of our assets using the NARM value measures. This shows that 70% of our pressure control assets have a score of 6 or more (58% 9-10) at the start of RIIO-GD3. Without intervention, this rises to 71% and 58% respectively by the end of RIIO-GD3. If our Preferred Option of investment is followed in RIIO-GD3, this falls back down to 69% and 56% respectively at the end of RIIO-GD3 with investment.

Pressure control Health Index	1	2	3	4	5	6	7	8	9	10	Total
Baseline start of RIIO-GD3	5	34	9	9	6	10	5	9	11	109	207
	2%	16%	4%	4%	3%	5%	2%	4%	5%	53%	100%
End of RIIO-GD3 w/o intervention	5	25	16	8	5	8	11	9	9	111	207
	2%	12%	8%	4%	2%	4%	5%	4%	4%	54%	100%
End of RIIO-GD3 with interventions	6	27	17	10	4	8	11	9	10	105	207
	3%	13%	8%	5%	2%	4%	5%	4%	5%	51%	100%

Table 7 Offtake and PRS pressure control Asset Health Scoring

As a note, we have seen a significant shift of PC assets (specifically regulators and slamshuts) from HI3-6 to HI10 in comparison with our latest RRP submission, following the updates for system reliability modelling from the LTRB project (Section 6). Further discussion with the Safety and Reliability Working Group (SRWG), responsible for the NARM Methodology, will be necessary to understand whether this is being seen across all GDNs and whether this is reflective of reality or whether a recalibration of the HI bandings for this asset class is necessary.

What is the outcome that we want to achieve?

From our stakeholder research (for example, see Insight 1, 9 and 10 from Appendix A3 in Table 8) we know that network reliability and cost remain our customers key priorities. Customers also value the importance of improving resilience against extreme weather, such as storms. From the risk analysis in Section 5 of this document, for this group of assets, environmental (carbon) followed by compliance risk is the main risk driver.

We know that our customers expect value for money and that we will make the right investment decisions for both our existing and future customers. We have proposed five objectives covering risk, cost, service, uncertainty and compliance. These will be used to determine how successful each option considered is at delivering against our customers' expectations.

What we heard	Appendix A3
Keeping bills as low as possible continues to be domestic and SME (Small Medium Enterprise) customers' top priority, however stakeholders are supportive of investment to respond to significant challenges of climate resilience and decarbonisation. Balancing the trade-off between investing now to future-proof and minimising expenditure to prioritise essentials poses a challenge.	Insight 1
Customers expect our top sustainability commitment to be keeping our infrastructure resilient. This means continuing to reliably supply customers in the short and long term, regardless of climatic conditions and impacts experienced by interconnected sectors (such as telecommunications, road networks etc). As customers are satisfied with the performance and availability of our services, they prefer us to maintain service levels at levels similar to today, and asked for us to reduce future risk with targeted investments to enhance removal, reduction, resistance and recovery strategies.	Insight 9
The impact of climate change requires us to proactively reduce the vulnerability of networks to storms, particularly in rural areas, and a collaborative, cross-network approach. 'Preventing supply interruptions from extreme weather by providing back up power' was the most highly valued service improvement among billpayers in our Customer Value Perception study (on average, respondents were willing to pay £0.53pp at 75%).	Insight 10

Table 8 Customer Insights

Risk Objective: to maintain total risk to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to manage total risk

We know that our customers value safety and reliability as their number one priority and without intervention total risk will increase by 19% for Offtakes and PRS (20% for pressure control, Table 5) within the RIIO-GD3 period. In addition we want to manage increasing risks to provide a safe working environment for our operatives and avoid loss of supply events. We will *aim* to maintain risk throughout RIIO-GD3 to plus or minus 10% from the RIIO-GD3 starting position, however we understand the need to balance this ambition with service and cost constraints.

We are on track to meet our NARM target in RIIO-GD2. As the regulatory landscape is likely to broadly remain the same in RIIO-GD3, we have seen no need to take a step change approach to risk and have therefore adopted a risk objective that is consistent with that adopted in RIIO-GD2.

Efficiency Objective = to minimise RIIO-GD3 spend over and above RIIO-GD2 levels

We want to ensure efficient costs – We know that our customers expect us to invest their money wisely and efficiently to enable a reduction in their bills. To do this we need to make sure we maximise value from our existing assets before we replace them, however, we must understand the whole life cost of the decisions we make to ensure we are doing the right thing both now and in the future. As risk is rising sharply in RIIO-GD3 it is expected that we will need to intervene on more assets than we have during RIIO-GD2 to meet our objectives around managing total risk. To avoid escalating costs we therefore need to think of pioneering solutions to ensure we are delivering value for money for our customers. Whilst our RIIO-GD3 spend exceeds our RIIO-GD2 spend at a total level, a significant proportion of this is compliance led driving the need for asset replacement (for example

to ensure ongoing compliance with Health and Safety legislation such as the Medium Combustion Plant Directive and the Pressure Systems Safety Regulations).

Our aim at outset is to maintain spend relating to asset health in RIIO-GD3 broadly in line with RIIO-GD2 levels, where this is possible. We discuss this in more detail in **Section 10.2**.

Our objective in RIIO-GD2 was to maintain cost. However, the objectives we are setting out are becoming increasingly conflicted with one another as we move into RIIO-GD3. For example, increasing rises in risk and supply interruption from deterioration in the asset health of our assets, alongside obsolescence and compliance are key drivers for additional investment in RIIO-GD3 over and above the levels we saw in RIIO-GD2. We view maintaining risk and service levels and delivering a reliable, safe and compliant network for customers as a higher priority than maintaining cost at RIIO-GD2 given the evidenced need for additional investment, which is shown and discussed in our options appraisal. We are continually committed to providing a balanced programme of work and delivering value for customers. We have therefore updated our efficiency objective in RIIO-GD3 to be to minimise cost in RIIO-GD3 over and above RIIO-GD2 levels.

Our unit costs are discussed in Section 8.6.

Service Objective = to maintain supply interruptions to the same level as the starting position of RIIO-GD3 (plus or minus 10%)

We want to continue to provide exceptional service

The key service measure for our PRS assets is the Total Expected number of Supply Interruptions. Table 1.06 of the 2023/24 Regulatory Reporting Pack (RRP) submission highlights that our current customer satisfaction scores for unplanned interruptions are exceeding the targets set by Ofgem (9.37 target against our actual performance of between 9.543 and 9.650 between 2022 and 2024). We therefore consider that current service levels are acceptable to our customers and provide a suitable benchmark.

As the regulatory landscape is likely to broadly remain the same in RIIO-GD3, adopting risk and service level objectives that are consistent with that adopted in RIIO-GD2 seems appropriate. Other Reliability metrics outlined in Table 1.06 demonstrate that we are currently operating a highly reliable network. Our aim therefore to maintain our RIIO-GD2industry leading service levels in RIIO-GD3.

From the analysis in the section above we understand that supply interruptions are increasing by 10% overall for Offtake and PRS (1% for pressure control Table 6) within the RIIO-GD3 period to a point where we would be expecting an a supply interruption approximately every 3 years at the end of RIIO-GD3 without intervention. Our RIIO-GD3 investments need to target this service measure and reduce it back down to a more acceptable level.

Certainty Objective = to ensure our investments pay back within 16 years

We will protect our customers from future uncertainty

To ensure the investments we make in RIIO-GD3 are right for both our existing and future customers, and to avoid the risk of asset stranding we must ensure that our investments offer a payback before either the asset life or a point in time where future uncertainty could reduce the forecasted benefits, whichever is the smallest time period. The RIIO-GD3 Business Plan Guidance states that a 16 year payback period is appropriate for the GD sector (page 45)[2], meaning that any new, refurbished or replaced equipment that pays back within this time frame will be deemed suitable for investment.

[2] https://www.ofgem.gov.uk/publications/riio-3-business-plan-guidance

Compliance Objective = to ensure we are compliant with legislation relevant to each asset class

We want to ensure compliance with all relevant Health and Safety, or technical Regulations.

During RIIO-GD3 we are required to undertake several interventions for compliance reasons. Failure to maintain our pressure control assets risks non-compliance with the Pressure Systems Safety Regulations (PSSR) which is mandated by the Health and Safety Executive (HSE).

How will we understand if the spend has been successful?

This asset class is covered within the NARM Methodology, and we have set a relative risk target on which we will annually report performance against.

In addition to the NARM target, we would expect to keep the number of supply interruptions from Offtake and PRS asset failure at a manageable level, ideally at the same level seen during RIIO-GD2. During the price control period we would also expect to see a reduction in the numbers of faults and remedials picked up during routine maintenance and PSSR inspections.

Our Decision Support Software allows us to understand various service measures associated with each asset and how these change over time with and without investment.

5.1. Narrative real-life example of problem

CASE STUDY 1 – VOLUMETRIC REGULATOR REPLACEMENT [redacted]

[redacted] is the sole feed to Whitby, the site also supplies gas into the 17bar system that feeds down the east coast and into the Hull area. It is a critical site for NGN. The project scope includes the replacement of 2 pressure reduction systems due to obsolete and poor condition equipment, a fiscal metering upgrade to allow for better measurement and as a result more accurate customer billing. The site configuration and set up also raised concerns from operational staff regarding the bunding surrounding the PRS equipment. This was originally installed for noise abatement as the previous regulators (a mixture of jetstream and V25) are reknowned for being noisy when operating. This requirement has been negated by choosing a regulator that suits the operating conditions but also ensures noise levels are manageable, it also improves working conditions for operational staff for regular maintenance activities.

5.2. Project boundaries

The boundaries of spend provided in this EJP relate only to the intervention on slam shuts and regulators at our offtake and PRS sites.

It includes all necessary project costs such as design, procurement of materials, construction (including labour and materials), commissioning and overheads. It does not include any other offtake or PRS assets such as the cost of pre-heaters, E&I, civils or meters for example, or LTS pipelines which are all covered under separate Investment Decision Packs A22.a to A22.g.

The costs of all interventions have been included within the options summary Table 12 Capex totals. However, the costs and benefits of associated with the regulator overhauls, lineguard cabinets and capacity upgrade (pipework) have not been included within our impact on risk or service levels or within the CBA analysis as the impact of these interventions are not able to be modelled under the NARM Methodology and so we have no industry agreed basis to do so. However, these elements are key components in protecting the underlying assets and ensuring they continue to operate safely and efficiently; as well ensuring that we remain requirement with relevant legislation. Therefore, we expect the benefits of these elements to be of a similar magnitude to those covered by the NARM methodology and represent value for money for customers over the time period to 2050. We outline this cost breakdown below in Table 9:

	CBA RIIO-GD3 Costs (£m)	Non-CBA RIIO-GD3 Costs (£m)	TOTAL (£m)
Non volumetric - Full system replacement	5.24		
Non-volumetric partial system replacement - per system (equal to 4 units)	2.02		
Volumetric - Replacement	4.00		
Capacity Upgrades - Regulator	3.17		
Regulator overhauls (don't fall under NARM)		1.05	
Lineguard Cabinets		6.20	
Capacity Upgrades - Inlet/Outlet Pipework		1.60	
TOTAL	**14.43**	**8.85**	**23.28**

Table 9 RIIO-GD3 CBA vs non CBA costs

6. Probability of failure

The Probability of Failure (PoF) is the probability an asset will fail at a given point in time. When justifying our RIIO-GD3 Capital Investment, our Cost Benefit Analysis uses the recently updated NARM methodology to calculate the failure rate of our Offtake and PRS assets. The NARM methodology algorithm used to calculate the initial failure rate (to which deterioration is applied) for each Failure Mode (apart from Fail Open/Closed) is:

Failure rate including factors = Failure rate excluding factors x Fault Detection Rate x Coastal Factor x Housing Factor x FS Factor x Flood Factor x Kiosk Factor

This section discusses how we have used the NARM methodology to understand the types of failure of Offtake and PRS assets as well as the rate of failure, or deterioration, which is a function of the assets attributes, age and condition.

Over and under pressure events from fail open/ fail closed events for Offtake and PRS pressure control are now analysed from a system reliability view perspective – further details are provided under Changes to the NARM Methodology section.

Types of Failure

A failure in an asset is defined as the inability of an asset to fulfil one or more of its intended functions to a standard of performance that is acceptable and gives rise to a detrimental outcome.

Failure Modes have been developed by modelling the outcomes rather than components of which there are many. This avoids the need to accurately identify root cause which can often be difficult to diagnose. The Failure Modes for pressure control consist of:

Release of Gas – failure of a pressure containing component of the system such as filter bodies.

High or Low Outlet Pressure – where concurrent failure of both regulators and the slam shuts result in either over pressurisation or partial or total loss of the downstream system. The failure rate and deterioration for under or over pressure events from fail open/closed events has been updated as part of the Long Term Risk project updates to the NARM Methodology. The new approach (updated NARM Methodology) models the reliability of the pressure regulating function at the system level. Pressure regulating equipment (component level) are modelled at a system level to ensure that any redundancy in the configuration is accounted for and is simulated in daily timesteps to show durations of outages of individual components. This avoids over or underestimating the impacts of component failure.

Fault and consequence data has been pooled from the Networks to derive:

- Failure rate and deterioration models
- Fail open and closed proportions given a component failure.
- Reactive repair times of failed components when detected.

Capacity – where the system has insufficient capacity to meet a forecast 1:20 peak day downstream demand.

General Failure – relating to other failures not leading to a safety, environmental or gas supply consequence such as failure of instrumentation or telemetry systems.

The Failure Rate for an asset is the frequency of failures at a given point in time, typically measured as the number of failures over a year. We use the Initial Failure Rate from the NARM methodology which has been elicited through structured and formal workshops and adjust it by age, asset attributes and condition to achieve a more accurate estimate for the initial likelihood of failure for an asset. These scaling factors are:

Condition Risk (Effective Age) – this is the modified default age of an asset according to its condition.

Location Risk – a multiplication factor is applicable for assets within 3km of the coast.

Housing Risk – a multiplication factor is applicable depending on whether the housing of the asset is above or below ground.

Kiosk Risk – a multiplication factor is applicable depending on the condition of the building/kiosk.

Fencing / Security Risk (FS Factor) – a multiplication factor is applicable depending on the condition of the fencing and security.

Flood Risk – a multiplication factor is applicable depending on the flood zone the asset is located.

Pressure Control			
Failure Mode	Total Expected no. of Failures		RIIO-3 Failure Rate
	Start RIIO-GD3	End RIIO-GD3	
Capacity	2.000	2.000	0.000
General Failure	63.911	64.445	0.534
High Outlet Pressure	40.983	41.029	0.047
Low Outlet Pressure	34.267	34.784	0.517
Release of Gas	19.023	21.898	2.875
Total	**160.184**	**164.157**	**3.972**

Table 10 Pressure control failure rates

Table 10 shows the number of expected failures split between different failure modes for pressure control assets. Without intervention in RIIO-GD3 the failure rate of our Offtake and PRS pressure control assets will increase by 4 (2.5%), predominantly driven by increases in Release of Gas failure. These failures will result in a response from our maintenance team and could result in a loss of supply for our customers. The number of failures is a leading indicator in understanding the condition of these assets.

Changes to the NARM Methodology

LTRB Updates

The NARM methodology has been updated since RIIO-GD2 to incorporate changes for long term risk modelling and some changes in failure rates and deterioration rates to better reflect reality. This was carried out as a cross GDN project, underwent a consultation process and is awaiting approval by Ofgem. Please refer to full details of updated methodology changes in the updated version of the NARM Risk Methodology document. A brief summary of the updates includes updates enabling GDNs to report on Long Term Risk (LTR) increases and impact of investments on this metric. Data has been pooled across networks enabling an update to deterioration curves to include an end of life (EOL) assumption to eliminate artificially high rates of deterioration towards EOL in the previous models in particular for Governor and Offtake and PRS mechanical assets - these now taper off towards end of life (EOL) and provide much more realistic LTR analysis. Pressure Control and governor's regulator and slamshut failure analysis was also updated, now providing a system view of reliability and failure in the updated version of the model. Mains deterioration was also reviewed as part of the project. The effect of these changes which have been implemented in the production of the GD3 business plan analysis is to better reflect the reality of operation of the above-mentioned assets. ICS performed a validation process on the results of the changes to the model and LTR as part of the project, but further validation across GDNs is required.

Updates to the methodology have been discussed with Ofgem during their development and have gone out to consultation. Formal approval is to follow on from the consultation. It was agreed with Ofgem that model updates as part of this project including Long Term risk would be used for RIIO-GD3 business planning purposes.

6.1. Probability of failure data assurance

The data used in our probability of failure calculations comes directly from the NARM methodology. The failure models are based on various industry standard guidelines (see GDN Asset Health Risk Reporting Methodology document) and the failure rates have been statistically derived using actual asset information such as age or material and historic failure data taking into consideration other influencing factors such as weather or temperature.

We have an annual process for gathering asset data from the business to support NARM RRP delivery, with majority of data coming ultimately from SAP. There is a documented process where the business leads supplying

the data carryout reasonableness checks on the data supplied to the Asset Strategy team, who then carryout validation and consistency checks.

Our 2024 Data improvement plan assess key areas of data for robustness and completeness:

Our **Core Asset Data** for Offtake and PRS includes location, fault data, health bandings, customers, capacity, obsolescence and maintenance costs. Each year we update the fault data within our systems as a requirement for Regulatory Reporting therefore this data is up to date as of 2023/24. Our Core Asset Data is assessed to be robust and complete.

Our **Asset Health and Failure Data** includes design specification, age, condition, duty, capacity, location and environmental health factors. All other factors within this category are static and are only updated when we install new assets. Our Asset Health and Failure Data has been assessed as having some data gaps and assumptions have been applied. This applies in particular to default condition data being applied to some kiosks and no condition data for fences or control systems. Through Smarter Work Management Systems, field work capture capabilities will be developed to improve this. If assumed condition assumptions are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention; and vice versa.

Our **Financial Data** includes all the financial data held in the core system that is used within the risk models. We have recently updated all the interventions costs within the system using historical project cost knowledge and SME input on current cost trends (See section 8.2). Data relating to cost nodes in the modelling have been inflated to 2023/24 prices using the Ofgem agreed inflation factors. Our Financial Data has been assessed as having some data gaps and assumptions have been applied. If assumed financial costs are lower than reality, this will lead to a conservative calculation of baseline risk and risk reduction on intervention, and vice versa.

It is recognised in the NARM methodology that the GDNs will have data gaps and will not hold the same level of asset data. To facilitate the population of the Monetised Risk modelling, a flexible but consistent methodology (with options) will be utilised to derive the Probability of Failure, Deterioration, Probability of Consequence and associated impacts of Intervention. This is set out in Table 6 of the NARM Methodology and ranges from Option A (GDN specific data from company systems) to Option B(Pooled/Shared data – where applicable) to Option C (Global/Assumed). Assumed data could be data that has been analysed to be representative of the population, arrived at by expert elicitation, or arrived at by researching relevant published studies/reports.

7. Consequence of failure

This section sets out the potential consequence were slam shuts or regulators at our PRS and offtake sites fail to operate as expected. We will consider the impact on customers, safety and the environment.

For each failure there may be a Consequence of Failure (CoF) which can be valued in monetary terms. In the NARM methodology the CoF is calculated as the Probability of Consequence (PoC) multiplied by the quantity and Cost of Consequence (CoC) and are linked directly to Failure Modes which categorise the asset failure.

Customer Risk

- **Offtake / PRS Site Failures** – a failure of the site resulting in loss of supply to downstream domestic, commercial or industrial consumers.

Health and Safety Risk

Pressure control assets fall within the scope of the PSSR. The intention of these Regulations is to protect against serious injury from the hazard of stored energy as a result of the failure of a pressure system or one of its component parts.

- **Down stream gas escapes / Explosion** – an explosion at the Filters asset itself or in the downstream network following failure. This could lead to subsequent death, injury and / or property damage. Failure of the asset can lead to an increase in downstream gas escapes, which in turn leads to an increased risk of explosion and injury / damage.

Carbon Risk

- **Down stream gas escapes / Loss of gas** - the volume of loss of gas from either the asset itself or in the downstream network constitutes the consequence of a failure. Environmental impact is assessed from the carbon equivalent of the gas lost.

Financial Risk

- **Down stream gas escapes / Loss of gas** - the volume of loss of gas from either the asset itself or in the downstream network constitutes the consequence of a failure. Financial risk is determined from the cost of the lost gas.
- The direct financial costs to the business for without-Intervention work to the assets such as such as repair.

All of these aspects of risk have been taken into account to analyse the impact on total risk with respect to the start of GD3 level for all of our options in Section 9, and within our cost benefit analysis.

Where the principal of total monetised risk, applied across the asset base, is:

Total monetised risk = PoF x PoC x CoC

Different supply/demand scenarios have not been considered during our modelling as the current NARM Methodology does not include analysis for this. This is a future update to NARM in gas distribution that has been identified within the Methodology document and will be reviewed by the networks through NARM working groups. Overall, we are forecasting a slow recovery from impacts of the cost of living crisis and total domestic demand is forecast to return to 2021 levels between 2029 and 2031 for the NE and NO distribution zones of our network. This is based on established econometric modelling and demand forecasting methodologies.

Although the NARM Methodology does not account explicitly for supply demand scenario analysis, the fault and failure data we currently base our modelling calculations includes data collected over a period of historic years, which goes back to before 2021. Consequence data from company systems also reflects the latest available view for our asset base at 2023/24 and is also based on data from historic events collected over a period of time. Therefore, we do not anticipate demand to have a material impact on our investment decisions or their benefits during GD3.

Our Commitment to Resilience

Chapter 5 of our Business Plan demonstrates our longstanding commitment to ensuring that we are able to operate and maintain a resilient network. We have formalised our Resilience Framework and developed a number of individual resilience strategies which allow us to maintain our high standards. Our Resilience Framework ensures that we continually review the hazards facing our business and assess whether mitigations that we have in place remain sufficient or need to change. This is relevant to our asset management strategies as we need to take into account exogenous factors when considering both short- and long-term investment plans. Our Network Asset Management Strategy which is set out in **Appendix A18** brings this all together.

We have introduced a range of other resilience strategies, such as **Appendix A8 – Climate Resilience Strategy**. A climate risk assessment sets out the risks facing NGN currently, in 2050 and in 2100, as set out in section 1.5.2 of

the strategy. The climate scenario risk analysis did not identify high risks for either the 2oC or worst-case 4oC warming scenarios assessed. As such, this recognises our resilience to material climate change risks in the long to very long term (2050+). This is due to our comprehensive asset integrity and management procedures that are in operation to ensure asset condition and performance. In addition, there is inherent resilience afforded by gas infrastructure assets being a sealed, pressurised system principally located underground. Resilience levels to climate change risks will be greater in lesser warming scenarios should they arise, due to lower climatic extremes. The likely current and future climate risk has been factored into our preferred strategies across Offtake and PRSs from the outset by utilising our SME knowledge and risk assessments mentioned above.

We are taking a similar approach to RIIO-GD2 in putting together our investment plan, taking a balanced approach to asset management to ensure a safe, reliant and compliant network – ensuring we can continue to meet our licence obligations whilst at the same time minimising costs for customers.

8. Options Considered

There are various ways in which we can intervene on our assets within this asset group. Each intervention has its own merits and drawbacks and the key to good asset management is to understand how the assets behave and use data and information to ensure the right decisions are made to balance risk and value to deliver a safe and reliable service for our customers. The interventions available for this asset group are:

- **Maintenance and repair** –pre-planned inspections and reactive repair works to ensure that performance is optimised, and the asset reaches its expected life. An example of this would be PSSR inspection on slamshuts, routine maintenance on regulators, VS02 inspection. This intervention is the basis of our baseline option (Section 8.1).
- **Refurbishment** – a proactive planned intervention which includes inspection and replacement or servicing of major components and soft parts with the intention of extending the expected life of the asset. An example of this would be replacement of soft parts in a regulator, replacement of individual components due to condition or obsolescence.
- **Replacement** – installation of a new asset to replace an existing asset, often because of poor condition, the new asset will be of the same capacity but likely be a newer model or design. An example of this would be the replacement of a PRS on a like for like basis but with newer/different equipment.
- **Addition** – installation of a new asset on our network to provide extra capacity or increased service levels, usually in response to increased growth, customer requests or a Cost Benefit Analysis assessment. An example of this would be replacement of a pressure control system with larger diameter regulators to allow for increased gas flow through the site.
- **Removal** – where we no longer require an asset, or we can manage our network in a more efficient manner we decommission and dispose of the asset from our network.

Future Energy Pathways

The assumed proportion of methane is important within the risk calculations and CBA as within the NARM methodology the carbon equivalent of the gas lost from our assets is quantified, resulting in a monetised Carbon Risk. Gas can be lost from our mechanical assets through leakage or failure. Civils and E&I asset condition and failure are important because they influence the failure rate of mechanical assets, and the duration of the loss of gas consequence respectively.

We have gone with the default assumption of current assumed proportion of methane CO2 in natural gas projected forwards due to uncertainties in the potential energy pathways and because this is reflective of the current gas quality legislation. However, we acknowledge that significant changes to gas demand or the allowed

methane content of gas, for example due to the blending with or conversion to hydrogen, would impact the benefits of our investments.

We have not explicitly modelled changes in the methane content of gas in our CBAs, as overall gas demand and the change in CO2 content of the gas is not expected to be different enough to materially impact the NPV, Payback & Option Ranking of our preferred investment programme. Our chosen programme represents value for money over a 20-year period regardless and is mainly driven by customer benefits such as avoiding loss of supply. The investments also ensure that we are compliant with relevant legislation. Our strategy therefore represents a no regrets investment programme that is consistent with net zero and will deliver value to customers whether a hydrogen or electrification pathway is chosen.

How we make Asset Decisions

We aspire to make conscious decisions that are balanced across our asset portfolio to ensure we can leverage the most value out of our assets. In making conscious decisions we can evaluate the risk we hold as a business and the impact it has on our strategic objectives. Asset management relies on accurate data, during RIIO-GD2 we have been working to improve our data and the way we capture and store this information, so it can be used to benefit our decision-making process. We use a wide range of asset data, global values such as the cost of carbon and specific values such as the loss of supply, costs from our updated unit cost analysis (see section 8.6) and the NARM methodology to calculate risk and value. Technical experts analyse options and set constraints (such as a constraint with the objective of maintaining risk) within our Decision Support Software which maximises the value of our investments for the given constraints. We use the value measures from our Decision Support Software in Ofgem's Cost Benefit Analysis template to compare the Net Present Value (NPV) of each option against the baseline option to determine the most suitable capital programme in RIIO-GD3. Figure 6 is a simplified representation of this process.

Options Analysis

We consider various options when making asset management decisions to ensure the interventions we undertake are in the best interests of our customers and are optimal in terms of asset performance, capital expenditure and risk management.

Our Decision Support Software is used to quantify risk and level of service measures and to aid asset management decision making. Optimisation within the software allows us to maximise the value of investments we are making, but we also combine this with bottom-up analysis and constraint application which comes from collaboration with our subject matter experts.

Our process for Offtake and PRS assets is to undertake asset class optimisations where we set different constraints for our options and use our Decision Support Software to optimise within each secondary asset class. By undertaking optimisations at this level, we are allowing the system to maximise the value from investments within each asset class. Once we have run these optimisations, we analyse the results in terms of risk, service and cost and use Ofgem's CBA template to understand the customer benefits derived from each option.

In the early stages of options analysis, optimisations were carried out in our decision support software to obtain the best value investments over RIIO-GD3, by applying constraints such as maintain risk and maintain investment cost with the objective of maximising value from intervention. The resulting intervention plan recommendations were then reviewed by SMEs, who fed back on specific site and asset intervention applicability providing additional bottom-up insights around factors such as obsolescence and compliance. This information was used to further develop the modelling and intervention selections by applying additional constraints within the modelling process.

A preferred option has been arrived at using a combination of bottom-up strategic analysis and optimisation using our Decision Support Tool (DST) to maximise the value of investments we are making. From this preferred option,

further sensitivity analysis is undertaken to see if we can in any way improve the option. This sensitivity analysis is undertaken at the asset class level looking at the different effects of refurbishment and replacement interventions, as well as seeing if there is more merit in delaying the investment. During this sensitivity analysis we will also run each asset class individually through Ofgem's CBA template to ensure that they have a positive Net Present Value and within a reasonable timeframe. This provides additional confidence that our decision support software hasn't been inadvertently constrained during the first stage and not been able to deliver the best value for our customers.

The different options we have modelled are set out below in Sections 8.1 to 8.5. These have been appraised against our objectives in Section 5 to determine a preferred option. In summary, we have produced a Maintain Total Risk programme option which we have deemed appropriate to maintaining a safe, reliable and compliant network. Subject matter experts were consulted to create reasonable Do More and Do Less options, with a particular focus on practical deliverability of the programme of works. It is important to note however that the options discussed have implications on a combination of safety, reliability and compliance which are discussed in the options analysis review. A deferral investment option was also considered.

Figure 3 How we make asset decisions

We provide a summary output schedule under each option and detailed information on how we have reached our unit cost assumptions are provided in section 8.6.

Ofgem CBA Template Assumptions

For all CBAs in our RIIO-GD3 submission, we used an assumed weighted average cost of capital (WACC) of 3.92% based on Ofgem guidance (a real average basis). We have assumed a depreciation Acceleration Factor of 100% across all CBAs and scenarios, i.e. no additional acceleration of depreciation. For Capex CBAs we have assumed a capitalisation rate of 33.7% based on our Totex forecasts in BPDTs and 100% for Repex CBAs. First year of

expenditure outflow is set to 2027 in all scenarios for consistent relative NPV calculations. This is in line with Ofgem guidance for RIIO-GD3 and the approach taken in RIIO-GD2. We consider that the plausible ranges of these parameters would not materially affect CBA outcomes and have provided only one version of templates with these consistently applied (as they can be adjusted by Ofgem in any case).

We have not provided direct Opex associated with each CBA scenario as it would require us to artificially and subjectively divide up our maintenance and repair expenditure into each sub-asset class (CBA) and make a judgement on how this would be affected by each scenario. We do not record or report data at this level and we have no robust basis on which to provide it. In reality, maintenance and repair teams attend to multiple asset classes in single visits as part of an efficient function. Instead, we have provided the objectively calculated VF Financial risk, which is based on agreed industry NARM based calculations for estimating impacts on Opex under each CBA scenario. For those asset groupings not covered by NARM we have only included benefits and impacts of key benefits e.g. leakage. We consider this to be a more robust and objective approach to our CBAs. We have completed the NARM monetised risk memo lines from values in the NARM BPDT for baseline and preferred where they are available and relevant.

8.1. Baseline – Do minimum/nothing

This option is used as the baseline for which all other options are measured against. It does not include any capital investment but instead considers the cost of ongoing maintenance activities and repairs on failure which is included within the financial risk element of the NARM modelling. There are no direct benefits accrued under this option, however it does include societal impacts associated with leakage, fatality and injury.

The baseline option shows that there will be an increase of risk of 20% and an increase of supply interruption levels of 1% above start of RIIO-GD3 levels if we were to adopt this Do Nothing/ Do Minimum option (Table 15). All categories of risk contribute significantly to this increase in risk apart from Customer risk and, Carbon risk slightly more so than others as the cost of carbon is increasing (Table 17).

Given our objective in Section 5 of maintaining risk levels, this option has been deemed to be unacceptable. It also puts meeting our compliance obligations at significant risk. It is however, the option against which the following options have been measured against.

8.2. First options summary – Maintain total risk (preferred option)

This option aims to maintain risk to an acceptable level, compared with our position at the start of RIIO-GD3.

It ensures compliance with our legal requirements under the PSSR to account for interventions required due to the age of our existing assets and their increasing obsolescence.

Our preferred option results in 139 interventions at a cost of £23.28m across RIIO-GD3.

This consists of:

- 5 Non volumetric full system replacements
- 10 Non-volumetric partial system replacements (equivalent to 40 units)
- 15 regulator overhauls (refurbishments)
- 100 lineguard cabinets (refurbishments)
- 2 volumetric full system replacements

- 3 capacity upgrades (regulator)
- 4 capacity upgrades (inlet/outlet pipework)

Investment drivers for these interventions are detailed against each asset type intervention in Section 5, but at high level they are obsolescence, compliance, asset health (condition) and capacity. Workload profile across RIIO-GD3 can be seen in Section 10.4.

Note that in all of the options considered, regulator overhauls and capacity upgrades were not possible to model in our risk analysis software as these interventions are not defined under the NARM methodology. Regulator overhauls involve replacement of soft parts only and did not meet the requirement of a NARM refurbishment. However, whilst there is no risk benefit included in the analysis, we did ensure that the costs were still taken into account within the cost benefit analysis. This will mean that the cost benefit results, NPV and payback period will be conservative.

The preferred option shows that there will be an increase of total risk of 15% and a decrease of supply interruption levels of 3% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 3-6% across all categories of risk (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are underdelivering on this risk objective (+15%) (Table 15). We are however meeting the objective for all of the risk categories apart from carbon under this option, the reason being the increasing cost of carbon (Table 17).

Service level objective (maintain SI levels +/- 10%) – we are meeting this risk objective (-3%).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – RIIO-GD3 spend under this option is comparable to forecast RIIO-GD2 spend levels (+£0.3m). We believe we are meeting this objective by using our SME's high level of site expertise and knowledge in combination with analysis in our Decision Support Software to develop a balanced programme of work meeting the requirement of workload driven by deteriorating asset health, obsolescence, capacity and compliance, whilst minimising the cost for customers in our investment solutions.

Uncertainty objective: This option pays back in 15 years delivering positive NPV from 2041 onwards. This meets Ofgem's requirement of paying back in less than 16 years.

8.3. Second options summary – Do more and increase volume of interventions by 20%

We have assessed a second option whereby we could increase the volume of interventions by 20%. Note that we have kept the capacity upgrades constant in this scenario given it would not be possible to intervene on more assets. This option would result in an acceleration of interventions in the RIIO-GD3 period. Under this option, interventions would increase to 166 overall, at a cost of £26.18m. The interventions for this Do More option consist of:

- 6 Non volumetric full system replacements
- 12 Non-volumetric partial system replacements (equivalent to 40 units)
- 18 regulator overhauls (refurbishments)
- 120 lineguard cabinets (refurbishments)
- 2 volumetric full system replacements

- 3 capacity upgrades (regulator)
- 5 capacity upgrades (inlet/outlet pipework)

The Do More option shows that there will be an increase of total risk of 14% and a decrease of supply interruption levels of 4% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 4-7% across all categories of risk (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are underdelivering on this risk objective (+14%). We are however meeting the objective for all of the risk categories apart from carbon under this option, the reason being the increasing cost of carbon.

Service level objective (maintain SI levels +/- 10%) – we are meeting this risk objective (-4%).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option costs £2.9m more than the preferred option. For this additional cost we do not see any significant decrease in either risk or service levels and compliance needs have been assessed to have been met by the Preferred option. This Do More option therefore does not align with our customers' expectations of keeping bills as low as possible.

Uncertainty objective: This option pays back in 14 years delivering positive NPV from 2040 onwards. This meets Ofgem's requirement of paying back in less than 16 years.

8.4. Third option summary – Do less and reduce volume of interventions by 20%

We have considered the impact of carrying out fewer interventions and scaling back our intervention plans from the preferred strategy by 20% across the board.

This Do Less option includes 112 interventions at a cost of £19.98m. The interventions for this option consist of:

- 4 Non volumetric full system replacements
- 8 Non-volumetric partial system replacements (equivalent to 40 units)
- 12 regulator overhauls (refurbishments)
- 80 lineguard cabinets (refurbishments)
- 2 volumetric full system replacements
- 3 capacity upgrades (regulator)
- 3 capacity upgrades (inlet/outlet pipework)

The Do Less option shows that there will be an increase of total risk of 16% and a decrease of supply interruption levels of 2% compared to start of RIIO-GD3 levels if we were to adopt this option (Table 15). We see the risk falls by about 3-5% across all categories of risk (Table 17).

In respect of our objectives set out in Section 5:

Risk objective (maintain risk +/- 10%) – we are underdelivering on this risk objective (+16%). We are however broadly meeting the objective for all of the risk categories apart from carbon under this option, the reason being the increasing cost of carbon.

Service level objective (maintain SI levels +/- 10%) – we are meeting this risk objective (-2%).

Efficiency objective (minimise RIIO-GD3 spend over and above RIIO-GD2 levels) – This option costs £3.3m less than the preferred option. For this decrease in cost, we see that our risk is more toward the extremities of the percentage limits we have placed on our maintaining risk objective. The reduced level of spend also places our ability to meet compliance (with PSSR regulations) at risk.

Uncertainty objective: This option pays back in 19 years delivering positive NPV from 2045 onwards. This fails Ofgem's requirement of paying back in less than 16 years.

8.5. Fourth option summary – Deferral of investment

The fourth option we considered was deferral of the investments detailed in option 8.2 (Maintain Risk) to RIIO-GD4. This was not modelled as it was not considered a viable option as it would put our ability to meet compliance (PSSR Regulations) at significant risk.

8.6. Options technical summary table

NGN's expenditure forecasts are built on a tried and tested, robust and efficient process. This is founded in asset management principles that has seen NGN consistently benchmarked as the most efficient gas distribution company by Ofgem since 2005. It should be noted that "robust and efficient costs" should not be interpreted as lowest cost. We have and are currently experiencing external and internal cost drivers that are increasing the cost to deliver some workloads and maintain service and compliance objectives. At NGN robust and efficient costs are defined as those which address the network, customer service and environmental risk in an effective and enduring way, to avoid future additional costs or service interruptions. Notably, Health and Safety and Security of Supply are priority drivers in determining the appropriate balance of risk and cost which enables investment decision making. As such, our costs are efficient over the life of the intervention and not just at a point in time, which would reduce cost but risk service failures or increased costs in future periods.

NGN's efficient and robust process to determine expenditure is as follows:

- Historic analysis of previous investment programmes to understand how expenditure has been effective in managing network risk (NARM) and the service levels that have been delivered. This provides the actual delivered cost of reducing risk and delivering services levels.
- Forward looking analysis of risk profile, cost drivers and pressures to understand what the forecast programme of work is and the cost associated with maintaining or enhancing performance. This allows a clear articulation of how actual delivered efficiency translates into future cost, accounting for any cost variance.
- A comparison of historic cost base versus forward projection to ensure costs are targeted at addressing compliance requirements (HSE), supply demand and account for additional costs drivers or challenging areas of work. To ensure costs are robust we embed the following process:
    - Compare asset specific costs against Third party industry database to understand where deviations from average costs might be and the reason for these changes. Third party data base provided by Aqua Consultants who maintain database for other regulated sectors.
    - Compare costs against Yr3 Industry RRP to assess how NGN costs compare to current delivered costs across GDNs (with Aqua Consultants highlighting that NGN's unit costs were competitive when compared to other GDNs).
    - Compare future investment programme to current actuals using Ofgem GD2 benchmarking to understand where NGN may be benchmarked on a like for like for like basis.
    - Undertake robust Internal challenge with Independently appointed experts to weigh pro's and cons of business case and relevance of costs to meet service levels and manage network risk.

- The costs are then deemed to be robust and efficient from an NGN perspective and will be subject to a final technical scrutiny by an external consultant to ensure costs, benefits and risk removal are justified.

As demonstrated above, the unit costs used in both our Cost Benefit Analysis and capital expenditure forecasts have been derived using historical project cost knowledge, SME input on current cost trends and current cost quotations, to provide confidence in their accuracy, consistency and credibility. Since the introduction of SAP HANA S4 in Oct 2019 we have captured project costs at a more granular level to support regulatory reporting and to aid future investment decisions. During RIIO-GD1 the Unit Cost Database (UCD) was developed, this used extensive volumes of project cost data to derive cost curve models and provide a cost trend allowing for an accurate cost estimate, the allowances for GD2 were driven by the UCD. External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs, but uncertainty risk relating to unit cost was built in during the development of the UCD in RIIO-GD1 and has carried through as these costs have been developed into the unit costs for developing the RIIO-GD3 business plan, as described below. The RIIO-GD3 unit rates incorporate analysis of efficient historical projects (note that we removed outliers from our sample in cases where we had identified things such as significant delays, unusually high mobilisation/demobilisation rates to ensure those inefficient costs were excluded). No explicit efficiency over and above this is included within this EJP appendix as our efficiency target is covered within the main business plan - a 0.5% Ongoing Efficiency (OE) target. This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem (refer to Chapter 6 of NGN's business plan).

As a reliable starting point, our RIIO-GD2 unit cost allowances were converted to 23/24 prices, RIIO-GD2 project costs and forecasts were then compared against the 23/24 allowances. Where there were significant variances time was spent with delivery and commercial Subject Matter Experts to thoroughly review those costs. Technology improvements (new functionality), resource scarcity and project management are examples of where we have seen deviations in the GD2 allowance, these have been reflected in the base RIIO-GD3 unit costs.

We have Framework partners in place for Capex delivery projects which improve certainty and ensure efficiency of costs.

Table 11 provides a summary of the assumed unit costs applied in modelling and CBA analysis for pressure control. For the avoidance of doubt, costs are shown in 2023/24 prices.

Intervention	RIIO-GD3 Unit Cost 23/24 prices
Non volumetric - Full system replacement	£1,048,963
Non-volumetric – Partial system replacement (per system)	£201,651
Regulator overhauls	£70,000
Lineguard Cabinets	£62,000
Volumetric - Replacement	£2,000,000
Capacity Upgrade - Regulator	£1,055,845
Capacity Upgrade – Inlet or Outlet Pipework	£400,000

Table 11 RIIO-GD3 unit costs

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment or Investment Design Life	Total Installed Cost (RIIO-GD3 Capex) 23/24 prices

Baseline (Do Nothing)	N/A	N/A	N/A	N/A	N/A
First Option Summary – Maintain Total Risk (Preferred Option)	2026/27	2030/31	139	7 - 40 yrs	£23,278,864
Second Option Summary – Do more and increase interventions by 20%	2026/27	2030/31	166	7 - 40 yrs	£26,181,130
Third Option Summary – Do less and reduce interventions by 20%	2026/27	2030/31	112	7 - 40 yrs	£19,976,598
Fourth Option Summary - Deferral of investment	2031/32	2036/37	139	7 - 40 yrs	£23,278,864

Table 12 Options Cost Technical Summary Table

Table 13 details how our output schedule would differ under each of the options:

Workload Intervention Volumes	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Preferred Option	24	33	27	26	29	139
Do More Option	34	32	33	32	34	166
Do Less Option	23	22	23	21	23	112

Table 13 workload intervention volumes by option

9. Business case outline and discussion

Option	Description	Objectives					Comments
		Maintain Risk (+/- 10%)	Maintain Supply Interruptions (+/- 10%)	Efficiency	Uncertainty	Compliance	
-	Baseline	Not Met (+20%)	Met (+1%)	N/A	N/A	Not Met	Does not meet the risk or complaince objective.
1	Preferred	Not Met (+15%)	Met (-3%)	Met using SME expertise (comparable to RIIO-GD2 spend)	Met (15yrs)	Met	All risk categories are managed to within maintain limits apart from carbon risk. All other objectives met.
2	Do More	Not Met (+14%)	Met (-4%)	Not Met - additional £2.9m spend	Met (14yrs)	Met	Additional spend results in decrease in risk position (although still not met) and SI levels. All risk categories are managed to within maintain limits apart from carbon risk. Misaligned with customers' expectations of keeping bills as low as possible.
3	Do Less	Not Met (+16%)	Met (-2%)	Cost Reduction (£3.3m) - refer to comments	Met (19yrs)	Not Met	Cost Reduction from Preferred option comes at slightly higher risk and supply interruption levels and importantly places compliance at risk. All risk categories are *broadly* managed to within maintain limits apart from carbon risk.
4	Deferral	Not modelled	Not modelled	Not modelled	Not modelled	Not Met	Places Compliance at risk

Table 14 Options appraisal summary

Table 14 details a summary of the options appraisal against objectives carried out in Sections 8.1 to 8.5.

In Summary:

The baseline option has been rejected as this increases risk levels over start of RIIO-GD3 levels significantly. This is unacceptable and misaligned with our objectives of maintaining risk levels. Our ability to meet compliance regulations is also at risk under this option.

Option 2 the Do More has been rejected as this costs an additional £2.9m (over the preferred option) does not result in any significant improvement in risk or service level position. This option is therefore misaligned with our customers' expectations of keeping bills as low as possible.

Option 3 Do Less comes at £3.3m less than the preferred option, delivering slightly worse risk and service levels. This option would however put our compliance with PSSR regulations at risk and fails the uncertainty objective with a payback that is greater than 16 years. For these reasons it has been discounted.

Option 4 Deferral has been discounted due to the risk to compliance.

Option 1 has been assessed to be the preferred option as it delivers the best balanced programme of work combating deteriorating asset health, compliance, capacity and obsolescence whilst minimising spend for customers. It maintains risk over RIIO-GD3 for all risk categories apart from carbon risk, due to the increasing cost of carbon and it also meets service level, efficiency, uncertainty and compliance objectives (see Section 8.2).

Our Preferred option is detailed in full in Section 10.1.

9.1. Key business case drivers description

This section discusses the development of the preferred strategy and sensitivity analysis then undertaken.

We have assessed the present value of each investment option utilising Ofgem's CBA template. To calculate all present value figures, we have compared the capital and operational costs associated with each option and overlaid them against the leakage reductions (associated with reduced numbers of failures) and reductions in risk relating to customer, compliance, financial and health and safety we expect each to attain.

All alternative options should be compared to the baseline counterfactual of the baseline position. The baseline position outlines what we expect our annual shrinkage position to be assuming zero interventions on pressure control assets across Offtakes and PRS. The present value of each alternative relates to our expected reduction in shrinkage given the funding received under each option. To value each of these efficiency gains we have used the non-traded price of carbon dioxide, as quoted by Ofgem. As noted above, each alternative option also analyses the impact of the change in customer, compliance, financial and health and safety risk. The preferred Strategy development is discussed in Section 8.2 with the options (sensitivity analysis) detailed in Sections 8.1 to 8.5.

The key drivers for investment in pressure control assets are obsolescence, compliance, asset health and capacity.

Obsolescence and Compliance: Given the obsolescence and reliability concerns, a phased replacement of the Audco Lineguard system with modern, supported alternatives has been recommended. This would ensure continued compliance with PSSR and reduce the risk of incidents.

Asset health: It is imperative that slam shuts and regulators remain in good condition in order to ensure gas continues to flow through our network in a safe and reliable manner. Regulator overhaul interventions are being driven by asset health, deteriorating assets. This intervention as in GD2 is being applied where we can act to improve the asset and improve its longevity. Where this has not been possible, replacements have been considered.

Volumetric full system replacements are also being driven by asset health (deteriorating condition). Non-volumetric replacements and partial replacements are also in the main being driven by asset health (deteriorating condition), although we are seeing some instances of lack of control on non-volumetric systems where control systems are not operating as they should resulting in increased faults and indicating intervention.

Capacity: Capacity constraint investments have been considered where we have sites already exceeding capacity limits, or narrowly approaching them (97%).

Further details can be found in Section 5.

Conditionalities included within our options analysis are detailed in Section 7.

9.2. Business case summary

The analysis results for each of the options detailed in Sections 8.1-8.5 are summarised in Table 15, Table 16 and Table 17. Options appraisal is detailed in Sections 8.1 to 8.5 for each option and option selection is detailed at the start of Section 9.

Option	Desciption	RIIO-3 Primary Interventions		RIIO-3 Secondary Interventions	Total NPV compared to Baseline at 2070 (£m)	Objectives			
		Replace	Refurb	Pipework Upgrade		Total Risk Change from 2026	RIIO-3 Total Capex Cost (£m)	Supply Interruption change from 2026	Payback (years)
-	Baseline	0	0	0	-£ 3,534.7	20.4%	£ -	0.6%	-
1	Preferred	10	125	4	£ 180.6	14.6%	£ 23.3	-3.4%	15
2	Do More	11	150	5	£ 208.4	13.9%	£ 26.2	-3.6%	14
3	Do Less	9	100	3	£ 144.4	16.4%	£ 20.0	-2.3%	19

Table 15 Options summary risk, SI impact and CBA

Option	Description	No. of Primary Interventions in RIIO-3	Forecast		Total NPV Compared to Baseline (£m)						Payback (years)	Total Risk Change from 2026	Supply Interruption change from 2026	Preferred Option
			Capex RIIO-3 (£m)	Totex RIIO-3 (£m)	2035	2040	2045	2050	2060	2070				
-	Baseline	0	0	0	-£ 199.7	-£ 312.7	-£ 426.1	-£ 540.4	-£ 1,986.1	-£ 3,534.7	-	20.4%	0.6%	N
1	Preferred	135	23.3	23.3	-£ 4.7	-£ 0.3	£ 4.8	£ 10.5	£ 91.8	£ 180.6	15	14.6%	-3.4%	Y
2	Do More	161	26.2	26.2	-£ 4.9	£ 0.0	£ 5.8	£ 12.2	£ 105.9	£ 208.4	14	13.9%	-3.6%	N
3	Do Less	109	20.0	20.0	-£ 5.9	-£ 3.2	£ 0.2	£ 4.0	£ 71.2	£ 144.4	19	16.4%	-2.3%	N

Table 16 Options summary including NPV

Option	Desciption	Risk Change from 2026					Total Risk
		Total VF Carbon Risk	Total VF Compliance Risk	Total Customer Risk	Total VF Financial Risk	Total VF Health & Safety Risk	
-	Baseline	24.8%	13.1%	1.1%	14.7%	13.1%	**20.4%**
1	Preferred	18.6%	7.8%	-2.2%	8.5%	7.8%	**14.6%**
2	Do More	17.9%	7.2%	-2.3%	7.8%	7.2%	**13.9%**
3	Do Less	20.9%	8.5%	-2.1%	10.7%	8.5%	**16.4%**

Table 17 Options summary detailed risk

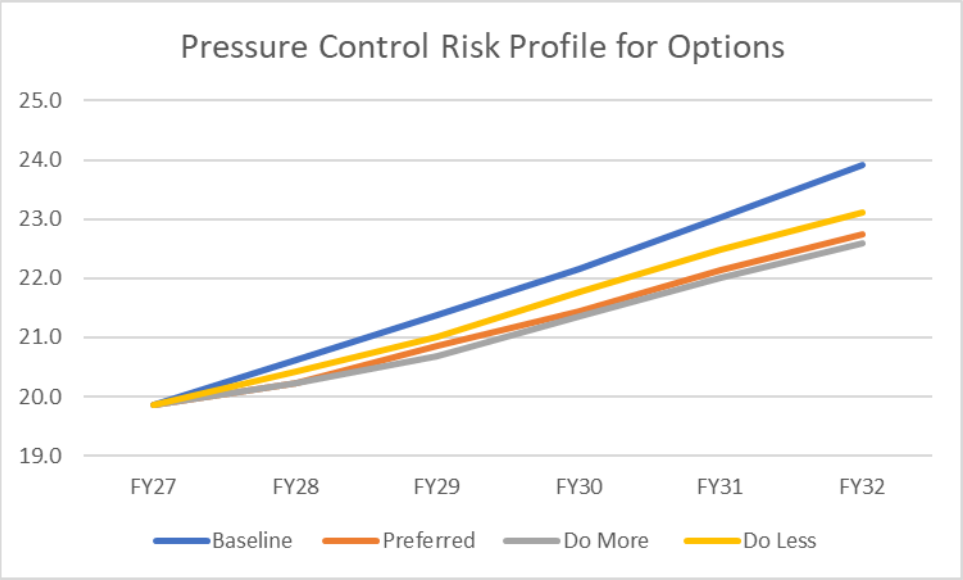

Figure 4 Pressure Control Risk Profile for Options

10. Preferred option scope and project plan

10.1. Preferred option

The preferred option is to carry out 139 individual interventions throughout RIIO-GD3 across our pressure control assets. This consists of:

- 5 Non volumetric full system replacements
- 10 non-volumetric partial system replacements (equivalent to 40 units)
- 15 regulator overhauls
- 100 lineguard cabinets (refurbishments)
- 2 volumetric full system replacements
- 3 capacity upgrades (regulator)
- 4 capacity upgrades (inlet/outlet pipework)

We have arrived at this position through a combination of the use of our Decision Support software to optimise the portfolio of assets to deliver the maximum value, whilst ensuring compliance with our legal requirements under the PSSR. A key consideration in this strategy has been the age of the existing assets given the increasing difficulties we are facing in sourcing replacement parts and the specialist knowledge to undertake the works. By upgrading our slam shuts we can ensure that our assets are standardised which is helpful from an efficiency point of view – this includes both the time for repairs to be carried out but also the cost of sourcing replacement parts.

As discussed in Section 9, this is the option that best balances the increase in investment cost to tackle asset health, obsolescence, capacity and compliance drivers for this asset class. Supply interruption levels are maintained within specified bounds (+/-10%), and we are also maintaining all risk categories apart from carbon within specified bounds (+/- 10%). This option also continues to deliver our objective of delivering against our efficiency, uncertainty and compliance objectives (see Section 8.2 and Section 9).

Costs for Pressure Control for the RIIO-GD3 EJP (£23.3m) are comparable to projected RIIO-GD2 spend (£23.0m) on a comparable 23/24 price basis. We are continuing to see increasing deterioration in asset health with some assets approaching end of life resulting in a shift from a predominately refurbishment focus in RIIO-GD2 to

replacement focus in RIIO-GD3. A Lineguard Cabinet programme has also been proposed in RIIO-GD3 due to reasons of obsolescence and to maintain compliance (£6.2m). Finally, also of note, 3 Capacity upgrades with associated pipework have also been identified as required in RIIO-GD3 to preserve the capacity of the network (£4.8m).

Long Term Risk impact on Preferred Option

Table 18 provides details of the Preferred option Capex spend alongside Single Year Risk benefit and Long Term Risk benefit output as shown in our NARM BPDT. Long Term Risk calculations allow for accrual of benefit over the life of the intervention. These intervention lives are detailed in full in our NARM BPDT submission. Section 5.2 Project boundaries detail the investments within our Preferred option where we have been able to model risk and risk reduction under NARM.

We have provided undiscounted Long Term Risk benefit both here and in the NARM BPDT. Further clarification with SRWG is needed around the requirement for discounting LTR.

	Capex Spend (£m)	Capex Spend (£m)	NARM BPDT	
	All Investments	NARM Modelled Investments	Single Year Risk Benefit (R£m)	RIIO-3 Long Term Benefit Output (R£m)
Pressure Control	23.28	14.42	1.41	31.97

Table 18 Long term risk for pressure control

10.2. Asset health spend profile

The total forecast capital expenditure for Offtakes and PRS's has been included within the accompanying CBA. Table 19 shows our spend per individual asset category across the 5 years.

£m 23/24 prices	2026/27	2027/28	2028/29	2029/30	2030/31	Total (£m)
Non-volumetric - Full system replacement	£2.10	£1.05	£0.00	£1.05	£1.05	**£5.24**
Non-volumetric partial system replacement - per system (equal to 4 units)	£0.40	£0.40	£0.40	£0.40	£0.40	**£2.02**
Regulator overhauls	£0.56	£0.49	£0.00	£0.00	£0.00	**£1.05**
Lineguard Cabinets	£0.62	£1.43	£1.36	£1.43	£1.36	**£6.20**
Volumetric - Replacement	£0.00	£0.00	£2.00	£0.00	£2.00	**£4.00**
Capacity Upgrades (regulator)	£1.06	£0.00	£1.06	£0.00	£1.06	**£3.17**
Capacity Upgrades (pipework)	£0.40	£0.00	£0.40	£0.00	£0.80	**£1.60**
Total	**£5.14**	**£3.37**	**£5.22**	**£2.88**	**£6.67**	**£23.28**

Table 19 spend profile

As demonstrated below, we have endeavoured to maintain consistency in spend as far as possible. Our lineguard investment is spread equally over the 5 years for example. As full system replacements are expected to cost either £1m (non-volumetric) or £2m (volumetric) we do experience some peaks and troughs in our spend across the years. We have staggered these interventions to take place in years 1, 3 and 5 to ensure adequate resourcing is available at the right times, but also so that we are not over burdening our engineering teams. Cost comparison between RIIO-GD3 and RIIO-GD2 is discussed in Section 10.1.

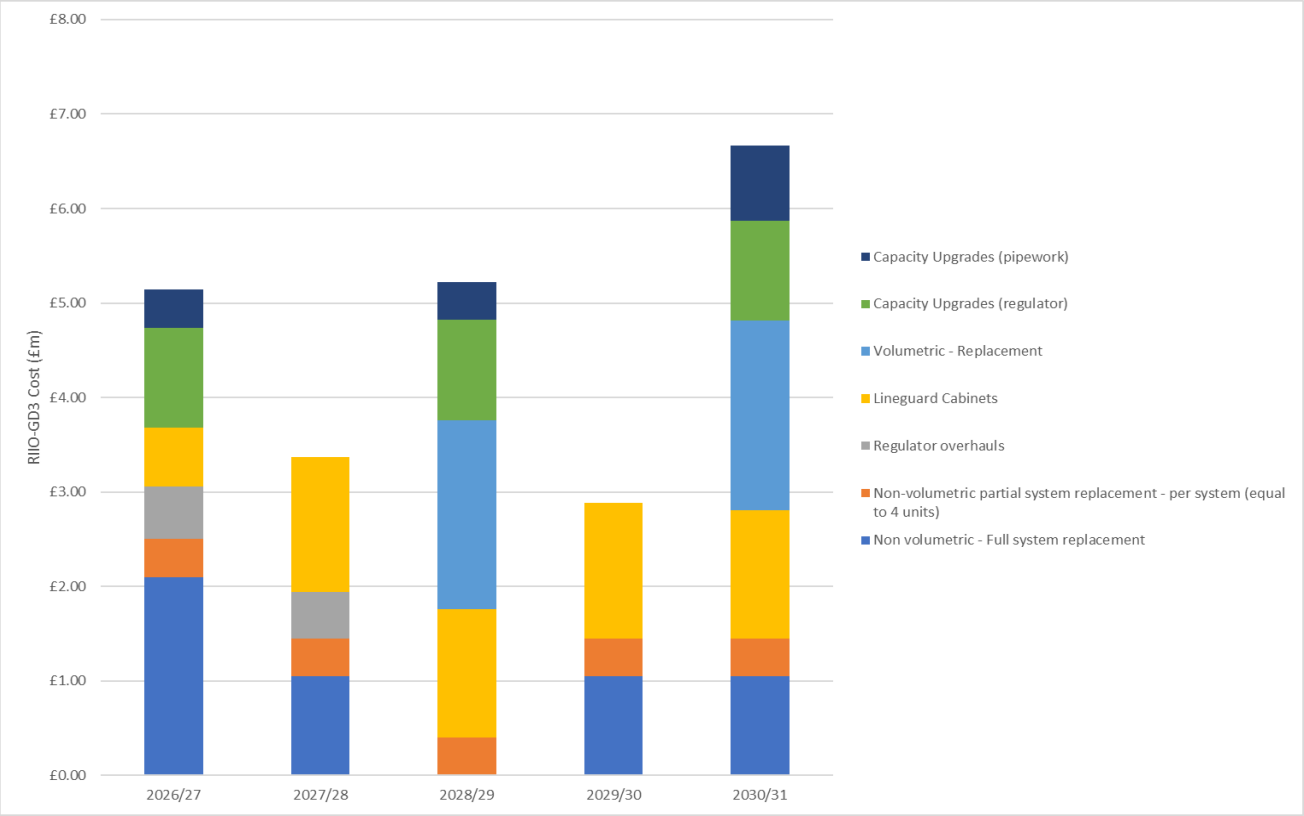

Figure 5 spend profile (£m)

Costs comparison for RIIO-GD3 against RIIO-GD2 has been included at the end of Section 10.1.

10.3. Investment risk discussion

We have controls and processes in place throughout the development of our RIIO-GD3 Capital Expenditure programme to ensure we mitigate both our customer's and our own exposure to risk. Workload and unit cost risks are inherent when forecasting failure rates and intervention solutions for large populations of assets. The bullet points below outline the steps we have undertaken to ensure we limit these risks to provide an accurate capital programme.

Workload Risk Mitigations

- We have used the NARM methodology to calculate individual assets Probability of Failure which uses asset attributes to determine specific failure rates.
- As most of our equipment installed on our Offtake and PRS sites are from a few select manufacturers. For example, regulators on our pressure control systems are sourced from a small number of manufacturers, primarily Honeywell, IGA and FIorentini. Of these, Axial Flow and Aperflux models comprise approximately 80% of our regulator population on high pressure sites. The result of this is that we have not witnessed significantly different failure rates across the populations.
- We have considered various options including workload volumes and chosen the solution which provides our customers with the most appropriate balance between cost, risk and service.
- There is an increase in workload for RIIO-GD3 over RIIO-GD2, therefore there are increasing risks around delivery of project workload to timescales, however we have experienced Project Managers who have a proven track record of delivering this type of work. Some Particular risks to delivery have been discussed in Key Business Risks (Section 10.5).

- We have consistently engaged on our preferred strategy with our SMEs and operational colleagues to ensure that our strategy is both viable and deliverable.
- As part of the above, we have ensured adequate internal and external resource for design and delivery.
- We have procurement strategies in place which take into account the likely volumes and lead times we could experience. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) has been developed with this in mind.
- Our project managers have been engaged throughout so that we have developed appropriate workload planning procedures.
- Land requirements have been factored into our project plans to ensure that they are dealt with well in advance of project construction to avoid undue delays.

Unit Cost Risk Mitigations

We have used our updated unit cost analysis (see section 8.6) to determine our unit costs.

We are not planning to undertake new work activities. We have undertaken all interventions previously and have historic costs allocated within our unit cost analysis.

We have experienced Project Managers who have a proven track record of delivering this type of work in the past and we have a commercial team of quantity surveyors who are focussed on delivering value for money.

We have well developed processes and assurance activities in place, with scrutiny and challenge provided throughout. This ensure that we can deliver value for money by driving cost efficiency. Details on unit cost processes are provided within Section 8.6.

Section 4.1 of **Appendix A7 – Workforce and Supply Chain Resilience Strategy** sets out some of the supply chain challenges that we have faced throughout RIIO-GD2. It acknowledges how NGN is a comparatively smaller GDN, which reduces our buyer power (section 4.1.2) and also discusses the significant inflationary pressures that have been placed on GDNs (section 4.1.4). For example, it discusses how the prices charged for coiled pipes have increased by 82% in the period from January 2020 to August 2023. In spite of these challenges, we are confident that our input unit costs remain efficient. This Appendix also touches on a number of external shocks which have impacted on things such as lead times. Examples include the Covid-19 pandemic, the Suez Canal blockage, Russia's invasion of Ukraine and rising geopolitical tensions. We outline in the strategy how we expect volatility to continue across our supply chain, and that we will utilise storage facilities in order to mitigate against supply input shortages. We plan to resource our supply chain and procurement team appropriately to help us overcome these challenges.

Appendix A21 – Cost Assessment and Benchmarking Approach demonstrates how, despite challenges facing us, NGN leads the industry in terms of cost efficiency, having been ranked the most efficient operator by Ofgem in both RIIO-GD1 and RIIO-GD2. This Appendix further outlines the value of NGN in Ofgem's cost assessment modelling at RIIO-GD2 by showing how NGN's frontier setting performance enabled Ofgem to set cost allowances that were £211 million lower than they would otherwise have been. In other words, our efforts to lead the sector on cost efficiency have resulted in significantly lower bills for consumers across the whole country.

We have achieved this position by being innovative in our thinking and directly and aggressively challenging industry norms and practices by bringing forward market-led, commercially focussed business solutions across almost every area of our business. For example:

- NGN introduced modern labour terms and conditions (T&Cs) for the majority of its operational workforce, leading to a significant reduction in legacy staff costs.
- NGN introduced a Direct Service Provider (DSP) model, leveraging small local engineering firms to deliver its replacement program instead of relying on the traditional 'tier 1' companies that have typically dominated the industry.

- Given that NGN has made strong productivity improvements over time, we have re-invested our outperformance payments in areas that (among other things) improve our productivity further. For example, we have used outperformance to invest heavily in IT systems through the SAP4 Hana investment and 'Future Ways of Working' programme. These projects are expected to significantly improve the customer experience and enable NGN to become a data-focused business.

We also outline in this Appendix our suggestion to target a 0.5% Ongoing Efficiency (OE) target, alongside the reasons why this is an appropriate level (see section 6 of the Appendix). This means that in reality, NGN will be subject to a further 0.5% cost reduction target throughout RIIO-GD3 in order to meet the OE objectives that will be set by Ofgem.

We outlined above how we have faced price increases significantly above inflation during RIIO-GD2. The Real Price Effects (RPE) methodology attempts to adjust for the difference between input price inflation and consumer price inflation. We outline in the Appendix our broad support for RPEs, however we note that during RIIO-GD2, all networks have seen relatively large swings in real term allowances year to year due to RPE and inflation volatility from the geopolitical energy shocks in 2022 and 2023. RIIO-GD3 therefore presents an opportunity to refine the basket of reference indices to better capture GDNs actual input price movements and better mitigate this risk. The impact of RPEs have not been factored into our unit cost pricing.

10.4. Project plan

This section sets out how we plan to deliver interventions across our pressure control assets throughout RIIO-GD3. The vast majority of our interventions relate to the installation of lineguard cabinets, though we also have 39 other interventions taking place over the period.

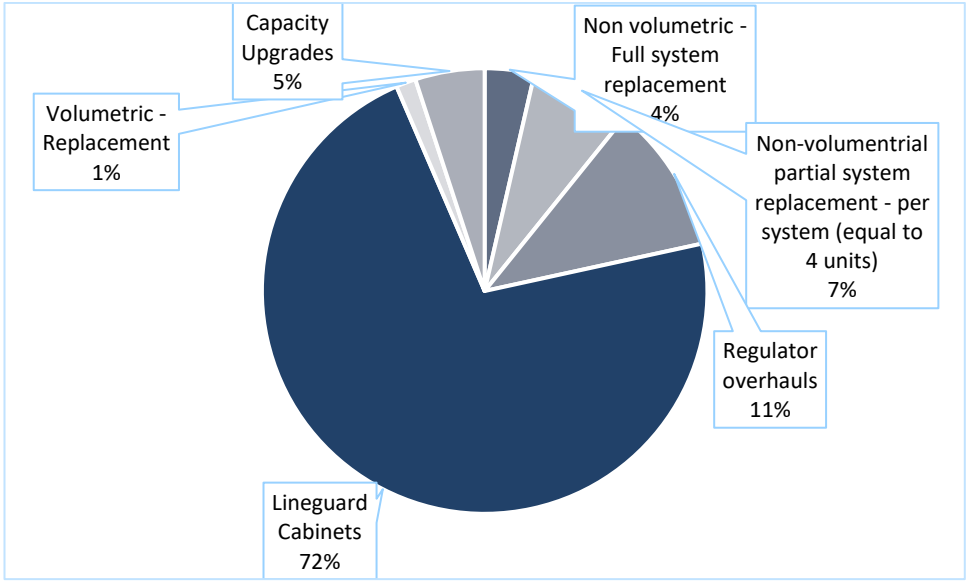

Figure 6 Workload intervention (%) Preferred option

As shown below, we have planned work throughout the period to ensure that we have a steady flow of interventions throughout the year. For example, we have staggered our system replacements to ensure that we are only undertaking one each year (with the exception of year 1 where we have reduced the number of lineguard cabinets in order to provide additional capacity).

Workload Interventions	2026/27	2027/28	2028/29	2029/30	2030/31	Total
Non volumetric - Full system replacement	2	1	0	1	1	**5**
Non-volumetric partial system replacement - per system (equal to 4 units)	2	2	2	2	2	**10**
Regulator overhauls	8	7	0	0	0	**15**
Lineguard Cabinets	10	23	22	23	22	**100**
Volumetric - Replacement	0	0	1	0	1	**2**
Capacity Upgrades	2	0	2	0	3	**7**
Total	**24**	**33**	**27**	**26**	**29**	**139**

Table 20 Planned pressure control intervention workload profile

Project planning is currently underway for RIIO-GD3. The screenshot below provides an insight to the level of detail to which we are going into developing Offtake and PRS investment projects, which are being planned at the site level. The excerpts show the timings and milestones for the key project stages of an example project. There is greater level of detail below this that can be drilled into.

A Risk Register for Pressure control investment over RIIO-GD3 is included within the CBA and the key risks and mitigations are covered in Sections 10.3 and 10.5.

10.5. Key business risks and opportunities

Risks

Internal delivery capability – Our RIIO-GD3 plan is ambitious and we have worked hard to ensure deliverability of the proposed work volumes. Our Workforce and Supply Chain Resilience Strategy discusses the likely resourcing challenges we will face during RIIO-GD3 and our plans on how to address them.

Contractor/resource availability – Risk around market resource for over 100 lineguard cabinets, the ability for these to be manufactured at a pace required by the delivery programme with the appropriate 'lead' time. As this work is large volume but small value it is likely that if some of the lineguard refurbishments are contracted out that they will be given to a single supplier as a rolling programme. It is vital to ensure that commercial value is extracted and that the delivery of the products meet the project installation timing requirements. We are employing early engagement and preparatory works in RIIO-GD2 year 4 and 5 to help mitigate these risks.

Cost variability - External Project management, untimely delivery by contractors and 3rd party delays could all impact on costs. However, framework partners who deliver the capex workload are rigorously challenged to deliver value for money and alternative partners are continually being used were cost or delivery is a challenge. Uncertainty risk associated with unit costs has also be built into the analysis for unit costs used in the RIIO-GD3 planning process (see Section 8.6 for further details).Supply chain risk – NGN have had issues with the supply chain recently (in particular for volumetric skids) and also issues with Liability levels associated with the failure of

equipment and the level of liability held by the manufacturer in the event of this. This has been recently resolved with one supplier. However, this is occurring more regularly and will need to continue to be closely managed in RIIO-GD3.

Temporary increased maintenance – Potential for "bedding in" periods of the new soft parts to cause maintenance callouts. This is a potential but will also be a temporary issue if it occurs.

NARM impact – Potential for NARM risk reduction to be impacted by the change in strategy. This will be closely monitored.

Opportunities

Obsolescence issues identified and plan initiated - While the original equipment manufacturer (OEM) has discontinued support for Audco Lineguard since the 1990s, individual components can still be maintained, albeit with limited availability of overhaul spares. Given the obsolescence and reliability concerns, a phased replacement of the Audco Lineguard system with modern, supported alternatives has been recommended. NGN has identified this problem and worked to put a plan in place for future replacement and general maintenance issues. This would ensure continued compliance with PSSR and reduce the risk of incidents.

Efficiencies – the level of efficiency depends on the site we are working on, the type of asset being replaced, and whether the site gas supply can be isolated. Ideally if we were carrying out 3 separate replacements (crossing asset types) on a single site we would look to do all the work at the same time to minimise mobilisation and demobilisation cost for instance.

We discuss in Chapter 5 of our Business Plan how we are mitigating against the immediate risks facing our business in the RIIO-GD3 period. In terms of network asset management we have identified asset condition deterioration, obsolescence and compliance – all of which are relevant to the pressure control interventions set out in our preferred strategy. There are also wider considerations which indirectly impact on our investment decisions. Our Workforce and Supply Chain Resilience Strategy (Appendix A7) sets out our plans to tackle potential future skills shortages. Whilst we are not envisaging specific skills shortages in the RIIO-GD3 period thanks to our long standing commitment to ensuring we have a 24/7, highly skilled workforce, we do need to ensure that our longer term investment proposals are deliverable given the future challenges we may face as an industry. This strategy also discusses how we ensure that we have a resilient supply chain that can withstand shocks and unforeseen circumstances. This is also an important consideration given the limited supplier and resource pool facing increased demand as we move towards Net Zero.

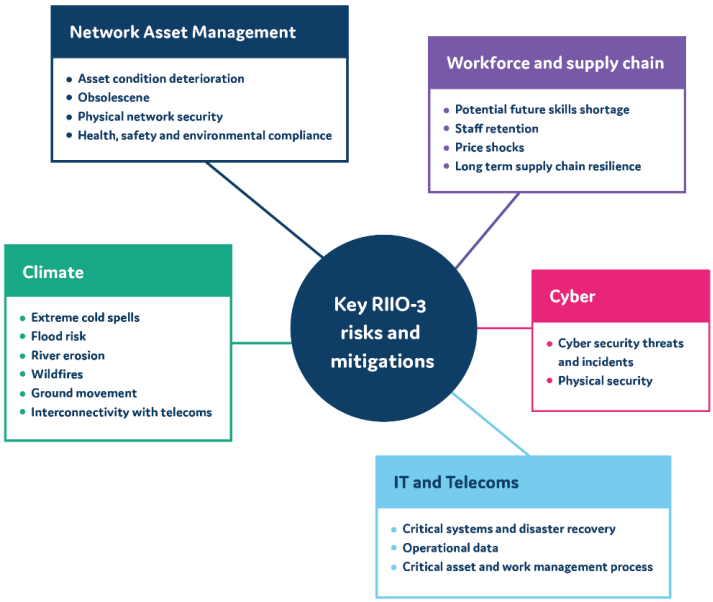

Figure 8 RIIO-GD3 Key Risks and Mitigations

10.6. Outputs included in RIIO-GD2 plans

We do not expect to carry over any RIIO-GD2 interventions into RIIO-GD3.