Northern Gas Networks

A23.H - NGN RIIO-2

Investment Decision Pack

Governors

we are the network

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2. Introduction

This Engineering Justification paper details our proposals for investment at our Governor sites during RIIO-2. It includes narrative for upgrades on our District Governors for both asset health and capacity (reinforcement) reasons and is to be used in conjunction with the accompanying Cost Benefit Analysis. It also includes narrative for upgrades on our Service Governors however as the proposed investment in RIIO-2 is below Ofgem's materiality threshold there is not an accompanying Cost benefit Analysis provided. This paper explicitly follows Ofgem's guidance and is set out in accordance with the headings therein.

Our Governors 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-1 we have undertaken a programme of works to upgrade the worst condition assets on these sites. As other assets deteriorate we will require a similar programme of works in RIIO-2 to ensure our gas transportation service continues to function safely and reliably.

This engineering paper aims to outline the justification for our proposed RIIO-2 Governor 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 Cost Benefit Analysis and how our proposed investment benefits our customers and stakeholders.

3. Equipment Summary

Governors are either above or below ground, predominantly housed, assets which regulate gas flows into or through our distribution network. They have below 7 bar inlets and supply intermediate, medium or low-pressure networks. Governors are key assets used in balancing pressures to ensure a 1:20 demand capacity is maintained whilst maintaining as low pressures as possible to reduce gas leakage. The failure of a Governor could lead to a loss of gas supply for customers and/or a release of gas. For Governors in a single feed network, failure would mean an immediate loss of supply as there is not an alternative Governor supplying gas to the network. For those Governors in multi-feed networks, depending on the characteristics and demand, failure of a Governor may still lead to a supply interruption or result in poor pressure. There are various types of Governor installed on our network which are detailed below:

District Governors – A pressure regulating system operating with an inlet below 7 bar supplying the intermediate, medium or low-pressure networks with more than ten customers.

I&C Governors – A pressure regulating system operating with an inlet below 7 bar, supplying large individual, commercial or industrial customers.

Service Governors – A pressure regulating system operating with an inlet below 7 bar, supplying domestic or smaller commercial or industrial customers. They tend to be in rural areas where there is no low-pressure network and directly supply customers from the intermediate and medium pressure networks. The assets can be split into three categories, those that supply a single customer, those that supply more than one but less than ten customers and those that supply greater than ten customers.

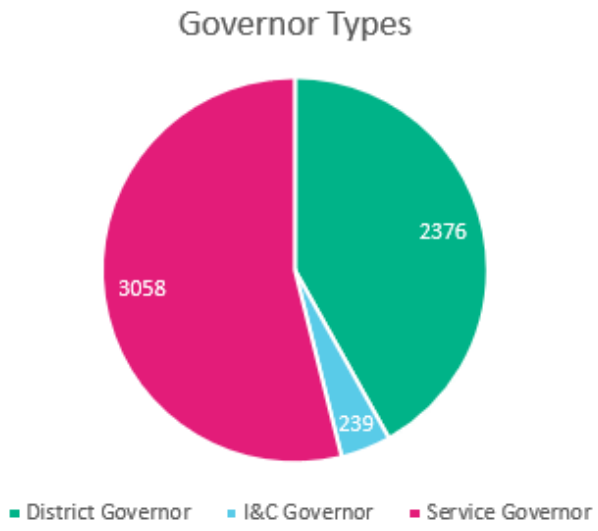
The following equipment at Governors are considered as secondary assets:

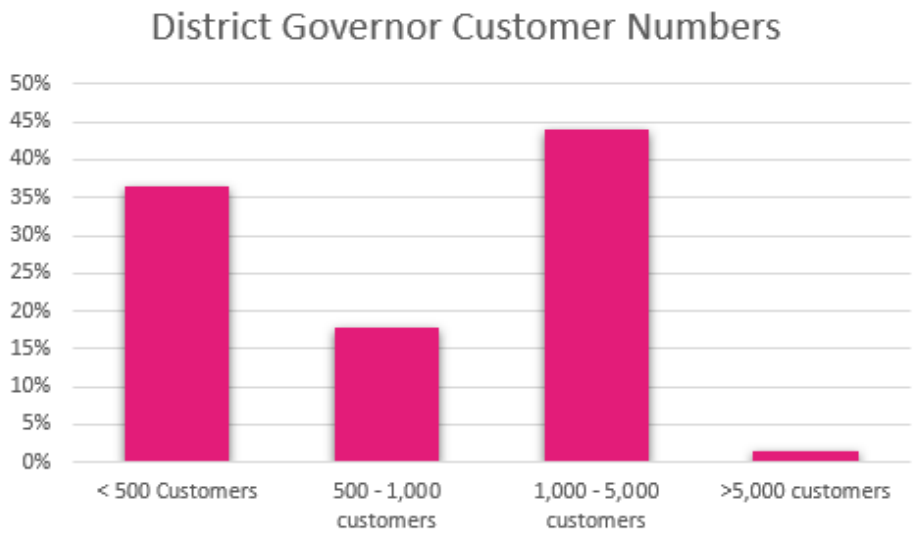
Control Systems – a small proportion of our more critical District Governors have full electrical, instrumentation and telemetry systems installed however all have a datalogger to record pressures which are communicated via GPRS. We control pressures at our District Governor sites in one of three ways. Seasonal settings where we visit site twice a year to set pressures for winter and summer periods, clock control which uses equipment to adjust pressures between two settings during the winter period or remote profile control which allows us to alter pressure at any time without the need to visit site.

Civils – District Governors tend to be housed in either brick buildings or GRP kiosks however housing can be made from various materials. Some Governors are also protected by security fencing and civil infrastructure such as walkways for safe access onto and around the site.

Cathodic Protection – We install cathodic protection on the steel inlet and outlet pipework to our District Governors to mitigate against the effects of corrosion.

The graph below shows the split by number of the various Governor assets:

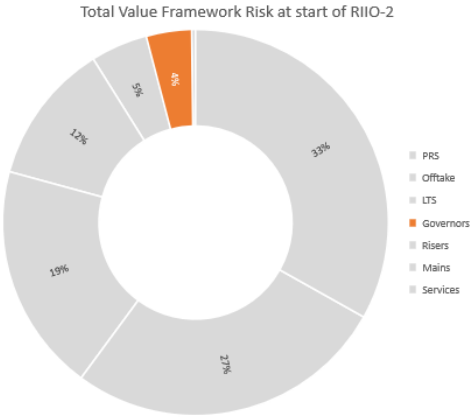




4. Problem Statement

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

We have developed a Value Framework which we use to calculate the risk we hold on our assets as well as to understand how the risk changes over time as our assets deteriorate. Governor assets account for 4% of our total network risk and include three primary asset classes: District Governors, Service Governors and I&C Governors. Within our Value Framework we report on risk in five categories: Compliance, Customer, Environmental, Financial and Health & Safety (further explained in Section 6 of this document).

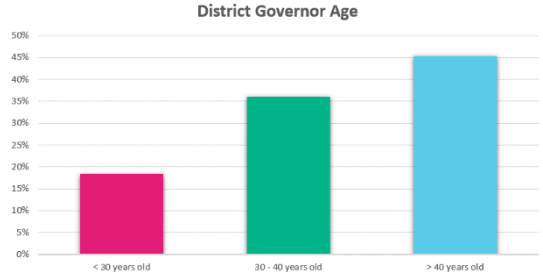


District Governors hold the most risk of the Governor population in RIIO-2 with 95% of total risk, Service Governors hold 4% and I&C Governors hold 1%. If you consider asset populations to understand the average risk per asset, District Governors still on average hold the most risk at nearly ten times that of I&C Governors and thirty times that of Service Governors. This paper only considers District Governors due to the materiality threshold set by Ofgem for NARMs asset classes and investments in Service and I&C Governors not meeting this threshold to warrant a Cost Benefit Analysis and Engineering Justification Paper.

Risk profile @ 2021	Compliance Risk	Customer Risk	Environmental Risk	Financial Risk	Health & Safety Risk	**Total Risk**
Distrcit Governor	£168,007	£4,121,994	£973,110	£1,185,833	£21,045	**£6,469,989**
%	3%	64%	15%	18%	0%	**100%**

The primary driver for investment is to reduce Customer risk which equates to c.64% of total risk as failure in this group of assets may lead to a loss of supply for customers. A secondary driver for intervention is to reduce Other Financial risk and Environmental risk which together equate to c.33% of total risk. Increases in Other Financial risk lead to a greater chance of incurring penalties or fines though consequences of failure such as loss of supply and increases in Environmental risk lead to a greater chance of incurring societal costs from carbon emissions.

If we do nothing in RIIO-2 total risk increases by 4%. By not investing in our assets in RIIO-2 every asset will move further along its deterioration curve and the probability of failure will increase. This may result in increased risk of loss of supply for our customers or increased risk of carbon emissions during RIIO-2 and beyond.



It is estimated that around 45% of our District Governor population will be over 40 years old in RIIO-2 without investment, however it is generally considered this type of equipment is robust and as such we experience relatively low numbers of faults. Recent asset surveys show these assets to be in relatively good condition considering their age, however they have highlighted many issues with the buildings in which the governors are located. Over RIIO-2, without investment, total District Governor risk will increase by 4% which is reflective of the condition and deterioration we are

observing. However, condition is not the only reason why we may need to intervene on a District Governor, during RIIO-1 a significant proportion of our interventions on these assets have been due to historical land issues where we have been required to relocate the governor due to easement or access issues. Another reason we have needed to intervene on these assets in the past is due to capacity constrains which means we need to replace the governor with a larger one to ensure we continue to meet our 1:20 supply obligations.

What is the outcome that we want to achieve?

From our stakeholder research we know that health and safety, reliability and cost remain our customers number one priority and we are seeing increasing importance placed on the environment. From the risk analysis in Section 4 of this document, for this group of assets, Customer is the main risk driver and so our objectives will focus around reliability. We also know that our customers expect value for money and that we make the right investment decisions for both our existing and future customers. Therefore, we have devised four objectives covering risk, cost, service and uncertainty.

We want to reduce total risk – We know that our customers value reliability as their number one priority and without intervention, risk will increase by 4% within the RIIO-2 period. We will aim to reduce risk throughout RIIO-2 however we need to balance this ambition with service and cost constraints.

Objective = to reduce total risk to below the starting position for RIIO-2

We want to ensure cost efficiency – We know that our customers expect us to invest their money as wisely and as efficiently as possible. To do this we need to make sure we extract the maximum value from our existing assets before we install new ones 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. In addition, with this asset class there are third party drivers for asset replacement that are not due to condition. However, this has been the case in RIIO-1 where we have managed our largest above ground asset class with relatively little investment (c.4% of the annual capital investment). Due to similar risk profiles over RIIO-2 we will be aiming to invest no more than the previous price control.

Objective = to invest no more each year than our average annual RIIO-1 spend (£2.2m/yr.)

We want to continue to provide exceptional service – The key service measure for our District Governor assets is the Total Expected number of Supply Interruptions. During RIIO-2 our Decision Support software forecasts that there will be four supply interruptions in RIIO-2 without investment. Our RIIO-2 investments need to target this service measure and reduce it back down to a more acceptable level.

Objective = to reduce the number of supply interruptions

We want to protect our customers from future uncertainty. To ensure the investments we make in RIIO-2 are right for both our existing and future customers and to avoid the risk of asset stranding, we aim for our investments to payback within a 20-year period which is a timeframe in which we expect minimal changes in demand on our network. In addition, we will consider extending the life of existing assets wherever possible as another means of mitigating against future uncertainties.

Objective = to ensure our investments pay back within 20 years

How will we understand if the spend has been successful? – This asset class is covered within the NARMS methodology and we have set a relative risk target on which we will annually report performance against.

4.1. Narrative Real-Life Example of Problem

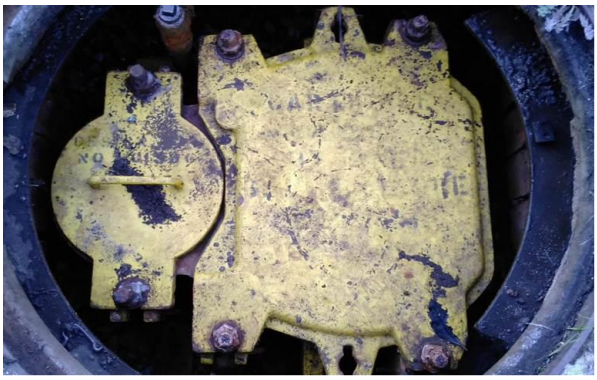
Case Study 1 – District Governor replacement

The District Governor pictured was located within a pub garden which presented our operational and maintenance teams access issues well as health and safety concerns for the public. During RIIO-1 the decision was undertaken to relocate the District Governor to a more suitable location. During the design engineering phase, we considered all options and found we were able to reconfigure the network by connecting two small low pressure networks to avoid installing a new Governor in a different location. This resulted in cost savings and less disruption for our customers.

Case Study 2 – District Governor refurbishment

The District Governor at Fimber Avenue was identified by our Maintenance and Network Analysis teams as a Governor which drooped and struggled to supply at peak demand. This capacity constraint increases our Customer risk as failure of one of the streams would lead to poor pressures or supply interruptions. We have a licence obligation to meet 1:20 peak demand and so a project was raised to upsize the asset. During the design engineering phase, it was determined that we could replace the regulators within the equipment rather than having to replace the whole asset. This saved our customers money and ensured continued reliability.

Case Study 3 – ERS module replacement



ERS modules are a type of District Governor which are located below ground usually due to land constraints. At the start of RIIO-1 these assets we obsolete and if we encountered issues the only option available was replacement of the Governor where we would usually try to bring it above ground. Through market stimulation refurbishment options have become available which we are now using successfully. The ERS module at Stella Road is an example of where we have refurbished due to condition. This cost-effective solution meant we were able to reduce Customer risk which could have led to a loss of supply for our customers.

4.2. Spend Boundaries

The boundaries of spend proposed by this justification paper include capital investment on the assets listed in Section 3. It includes all necessary project costs such as design, procurement of materials, construction, commissioning and overheads. It does not include any costs associated with mains laid or abandoned or security including fencing as these costs are included within the 'Repex' and 'Other Capex' Business Plan Data Tables in accordance with regulatory reporting.

5. 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-2 Capital Investment, our Cost Benefit Analysis uses the NARMS methodology to calculate the PoF of our Governor assets. The NARMs methodology algorithm used to calculate the PoF for each Failure Mode is:

PoF = Initial Failure Rate x (exp[(Effective Age – Default Age) x Deterioration Rate]) x Coastal Factor x Housing Factor x FS Factor x Flood Factor

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

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. In the NARMS methodology these failures have been categorised into Failure Modes, for Governors these are:

Capacity Failure – where the Governor is undersized to meet downstream demand

Fail Closed – where a fault with the regulator has resulted in it failing in the closed position

Fail Open – where a fault with the regulator has resulted in it failing in the open position

Interference Failure – where a third party affects the performance of the asset

Corrosion Failure – where corrosion of the Governor pipework leads to a gas escape or corrosion of the Governor components leads to regulator failing in the fail open / close position

Governor Failure – background leakage or shrinkage from the Governor

Control System Failure – failure of the telemetry, electrical or instrumentation systems or the pressure profiling equipment

Rate of Failure

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 have used the NARMs models to calculate the Failure Rates which are based on two methodologies:

Failed open and closed methodology – this is where failure rates for components have been derived from RCM fault data and the probabilities combined to take account of the Governor configuration (equipment in parallel or series) and then further adjusted for its assets attributes. A fault detection rate is then applied to take account of faults not identified through RCM.

Other failure modes methodology – this includes capacity, corrosion, emissions, interference, control systems and loss of control. For each failure model the actual number of faults were taken over several years and divided by the total number of assets to give an annualised failure rate.

For further detail on the failure modes see the NARMS methodology document.

The Initial Failure Rate, calculated as above, is then adjusted 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 the condition of the housing

Fencing / Security Risk – 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

We use the deterioration rate per the NARMs methodology for the Governor asset class. Weibull curves and expert elicitation derived different failure rates for the Failure Modes. Fail open and fail closed has a 5% per annum deterioration rate applied, corrosion has a 5% per annum deterioration rate applied, control system and loss of gas have a 10% per annum deterioration rate applied and emission has no deterioration rate applied.

The tables below show the Failure Rates of each primary asset at 2021/22 and 2025/26 without intervention and the rate of failure over the RIIO-2 period:

District Governors			
Failure Mode	Total Expected no. of Failures		RIIO-2 Failure Rate
	2021/22	2025/26	
Capacity	171	171	0
Control System Failure	252	416	164
Corrosion	7	7	1
Fail Closed	0	0	0
Fail Open	0	0	0
Interference	60	60	0
Total	**490**	**655**	**165**

Industrial and Commercial Governors			
Failure Mode	Total Expected no. of Failures		RIIO-2 Failure Rate
	2021/22	2025/26	
Capacity	22	22	0
Control System Failure	6	10	4
Corrosion	1	1	0
Fail Closed	0	0	0
Fail Open	0	0	0
Interference	6	6	0
Total	**35**	**39**	**4**

Service Governors			
Failure Mode	Total Expected no. of Failures		RIIO-2 Failure Rate
	2021/22	2025/26	
Capacity	0	0	0
Control System Failure	0	0	0
Corrosion	7	8	1
Fail Closed	4	6	1
Fail Open	0	0	0
Interference	83	83	0
Total	**94**	**97**	**2**

The above tables show the number of expected failures split between different failure modes, these are specific to asset classes. 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. The tables show that without intervention in RIIO-2 the failure rate of our District Governor assets will increase by 28%.

5.1. Probability of Failure Data Assurance

The data used in our probability of failure calculations comes directly from the NARMs 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.

Our **Core Asset Data** for Governors 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 2018/19. It is scored as amber within our Data Improvement Plan for NARMs. Our core data for District Governors is good which represents 95% of the total monetised risk within this asset class, however there are gaps in our core data for some I&C and Service Governors.

Our **Asset Health and Failure Data** includes design specification, age, condition, duty, capacity, location and environmental health factors. We are currently undertaking condition surveys on all our District Governor and I&C sites and are c.50% of our way through this programme, the data for the remaining 50% were last surveyed during 2012/13. We also completed a Service Governor survey programme in 2015. Our Asset Health and Failure Data is scored as amber within our Data Improvement Plan for NARMs which means there are some data gaps and assumptions have been applied. We are using default condition scores for many of our Service Governors and for most kiosks and fencing.

Our **Financial Data** is scored as amber within our Data Improvement Plan for NARMs which means there are some data gaps and assumptions have been applied.

We have submitted an update to our Data Improvement Plan in 2019 which outlines how we intend to improve our data so that the Monetised Risk is reflective of our network assets and current maintenance regimes.

6. Consequence of Failure

For each failure there may be a Consequence of Failure (CoF) which can be valued in monetary terms. In the NARMS 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.

Types of Consequence

The NARMS methodology sets out the Consequence Measures for each Failure Mode categorised into four risk groups: Customer Risk, Health & Safety Risk, Carbon Risk and Other Financial Risk. These are detailed below for Governor assets:

Customer Risk

Over-pressurisation – where the downstream network becomes over pressurised and can result in either an explosion or supply interruptions. Linked to the following Failure Mode: Fail Open.

Supply Interruption – where customers in the network downstream of the Governor lose their gas supply. Linked to the following Failure Modes: Capacity, Fail Open and Fail Closed.

Health & Safety Risk

Loss of Control – where sub optimum pressure leaves the Governor station but is not severe enough to result in a supply interruption but could lead to an explosion. Linked to the following Failure Mode: Fail Open.

Explosion – an explosion at either the Governor itself or in the downstream network resulting in death, injury or property damage. Linked to the following Failure Modes: Interference, Corrosion and Fail Open.

Governor Gas Escape – an increase in gas escapes in the downstream network resulting in a carbon an explosion or loss of gas. Linked to the following Failure Modes: Interference and Corrosion.

Carbon Risk

Loss of gas – volume of loss of gas from either the Governor itself or in the downstream network. Linked to the following Failure Modes: Interference, Corrosion and Fail Open.

NGN's Value Framework

We have developed a Value Framework which we use to assess the value of intervention options consistently across asset classes. We use the NARMs 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. 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 NARMs 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 and values specific to our business such as the cost of maintenance or the cost of loss of supply. The quantities we use 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-2 capital programme the monetary value of each Consequence Measure is calculated to determine the benefit or avoided cost of an intervention. Examples include:

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 NARMS methodology.

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 NARMs models.

Compliance Risk – Avoided GDN costs through a reduction in costs of fines and paying for explosion damage. These costs are in accordance with the NARMS methodology. They have been separated from direct Financial Risk as we consider them highly uncertain and likely significantly under estimated by the values in NARMs, 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 NARMS 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 NARMS methodology and industry approved values.

Probability of Consequence

Within our assessment of asset risk, we use the Probability of Consequence data from the NARMS methodology which has been calculated from a mix of observed data, shared GDN data, industry standard data and expertly elicited data.

7. Options Considered

Types of Intervention

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 a repair of a leaking Governor roof.

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 is would be a direct swap of one of the regulators within the Governor asset to replace a faulty component with a new one.

Replacement – installation of a new asset to replace an existing asset, often because of poor condition, the new asset will of the same capacity but likely be a newer model or design. An example of this would be the replacement of a District Governor including the kiosk and if relocated to a new location including land purchase, mains and new concrete slab and walkways. Another example could be just the replacement of the kiosk due to condition.

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

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 investments.

Arup conducted analysis on the potential benefits of our H21 Programme (see A13 - NGN RIIO-2 Consumer Value Proposition) that showed 45% of the gas in our network is expected to be Natural, 15% biomethane and the remaining 40% hydrogen by 2040; due to a combination of blending and sub-areas of our networks being fully converted. This is consistent with Net-zero by 2050 aligned with the ENA Navigant report.

We have not explicitly modelled changes in the methane content of gas in our CBAs, as overall gas demand and the change in C02 content of the gas is not expected to be different enough to materially impact the NPV, Payback & Option Ranking of our preferred investment programme. This is because carbon risk benefit accounts for only 15% of overall risk benefit and this will be reduced by up to 40% by 2040 across all scenarios if the ambitious but realistic ENA Navigant report pathway is chosen. Our chosen programme represents value for money over a 20-year period regardless and is mainly driven by customer and financial benefits such as avoiding loss of supply or repair costs. 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 our 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-1 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 value such as the cost of carbon and specific values such as the loss of supply, costs from our Unit Cost Database and the NARMs methodology to calculate risk and value. Technical experts analyse options and set constraints 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 scenario to determine the most suitable capital programme in RIIO-2. The diagram above 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 process for our Governor assets is to undertake 'individual asset class optimisations' where we set different constraints for our options and use our Decision Support Software to optimise within the asset class. Once we have chosen a preferred option, and further sensitivity analysis is undertaken to see if we can in any way improve the option. This sensitivity looks at the different

effects of refurbishment and replacement interventions, as well as seeing if there is more merit in delaying the investment.

7.1. Option Summary

Stage 1 – Individual Asset Class Optimisations

The investment options considered for District Governors are listed below and have the following in common:

- All options use standard unit costs for different types of assets and interventions which have been derived from historical costs using our Unit Cost Database. For more information on unit costs see Section 7.3.
- The programme of works will be delivered evenly over the five year price control period.
- The primary benefit delivered by these intervention options is a reduction in Customer risk which relates to reducing the probability of a loss of supply event for our customers.

7.1.1. Baseline - Do nothing / minimum

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. There are no direct benefits accrued under this option however it does include societal impacts associated with leakage, fatality and injury.

7.1.2. Option 1 - Reduce Supply Interruptions by 25%

This option uses our Decision Support software to optimise the portfolio of assets to deliver the maximum value whilst constraining the system to reduce supply interruptions by c. 25%.

7.1.3. Option 2 - Reduce Supply Interruptions by 50%

This option uses our Decision Support software to optimise the portfolio of assets to deliver the maximum value whilst constraining the system to reduce supply interruptions by c. 50%.

7.1.4. Option 3 - Reduce Supply Interruptions by 75%

This option uses our Decision Support software to optimise the portfolio of assets to deliver the maximum value whilst constraining the system to reduce supply interruptions by c. 75%.

7.1.5. Option 4 – Reduce Supply Interruptions by 95%

This option uses our Decision Support software to optimise the portfolio of assets to deliver the maximum value whilst constraining the system to reduce supply interruptions by c. 95%.

Stage 2 – Individual Asset Class Sensitivity Analysis

7.1.6. Option 5 – Pre-emptively replace only (preferred option)

This option considers the preferred option from Options 1 – 4 and analyses the effects of replace versus refurb interventions. It uses the total workload derived from the preferred option and uses our Decision Support software to optimise value whilst constraining the system to only allow replacement of the assets.

This option is different to the other options in that the only interventions considered are full replacements.

7.1.7. Option 6 – Pre-emptively refurbish only (preferred option)

This option considers the preferred option from Options 1 – 4 and analyses at the effects of replace versus refurb interventions. It uses the total workload derived from the preferred option and uses our Decision Support software to optimise value whilst constraining the system to only allow refurbishment of the assets.

This option is different to the other options in that the only interventions considered are refurbishments.

7.1.8. Option 7 - Deferred investment (preferred option)

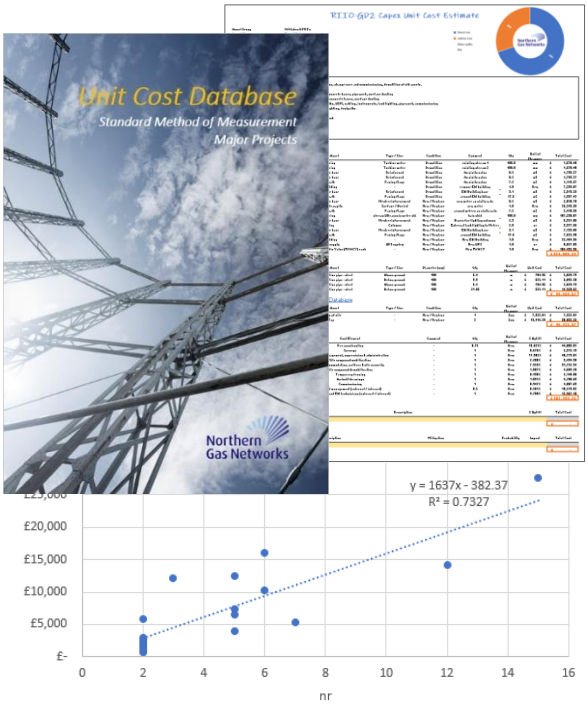
This option considers the effects of deferring investment until RIIO-3. This option delivers the baseline 'do nothing / minimum' solution during RIIO-2 and then undertakes the preferred option from Options 1 – 4 during RIIO-3.

7.2. Options Technical Summary Table

Option Title	First year of spend	Final year of spend	Workload Volume	Design Life (Refurb / Replace)	Total Capex RIIO-2 Cost
Baseline	-	-	-	-	-
Reduce Supply Interruptions by 25%	2021/22	2025/26	114	10/40 years	£5.88m
Reduce Supply Interruptions by 50%	2021/22	2025/26	218	10/40 years	£11.02m
Reduce Supply Interruptions by 75%	2021/22	2025/26	292	10/40 years	£18.59m
Reduce Supply Interruptions by 95%	2021/22	2025/26	326	10/40 years	£22.24m

7.3. Option Cost Summary Table

The unit costs used in both our Cost Benefit Analysis and capital expenditure forecasts have been derived using our Unit Cost Database (UCD) to provide confidence in their accuracy, consistency and credibility. We have developed our UCD during RIIO-1 and is a set of processes and systems used to allocate the costs of our capital projects to assets. We have developed a standard method of measurement which is a measurement rule book which details what costs should be included and excluded in a assets costs as well as detailing how the asset should be measured. These rules ensure that costs are allocated accurately and consistently to assets and the measures (e.g. m^2) capture the asset quantity delivered. All our capital project costs in RIIO-1 have been input into this database which has allowed for a significant number of data



points for each asset providing greater cost confidence. The UCD uses these data points to derive cost curve models which provide a cost trend for a given yardstick and allows for an accurate cost estimate for a given asset based on actual historic costs. A cost estimating template is used to build up the individual elements of an asset intervention such as the indirect costs associated with construction projects such as mobilisation, site set up and welfare, and direct costs such as civil, mechanical and E&I costs associated with the intervention.

The table below shows our unit costs in 2018/19 prices which have been used in our CBA options analysis and the final proposed RIIO-2 capital expenditure forecasts. In addition, we have detailed what is included and what is excluded from the unit costs.

Asset Class	Intervention	Unit Cost (£m)	Inclusions / Exclusions
District Governor Building	Replace	£0.013	**Unit costs include:** design, procurement, construction, and NGN overheads. Walk-in or Walk-through GRP building in accordance with GIS/PRS/35. Work includes supply and delivery of GRP building, with all internal fixtures & fixings, lifted into place, fixed to the base, grouting around building to base, and any associated furniture and fixings. Includes repairs or new concrete base where required. **Unit costs include:** Pipework alterations, new District Governor asset.
District Governor	Refurb	£0.015	**Unit costs include:** design, procurement, construction, commissioning and NGN overheads. Works can include but not limited to, replacement or refurbishment of components parts such as slamshut, filter basket, regulator, wafer check, auxiliary pilots, relief valves, clock and includes grit blasting and painting. **Unit Costs exclude:** Replacement of DG or building
District Governor ERS	Replace	£0.156	**Unit costs include:** design, procurement, construction, commissioning and NGN overheads. Provide and install skid mounted governor lift, fix to floor and associated pipework. Skid comes complete with all valves and flow control. A kiosk is provided over the governor to comply with GIS/PRS/35. Pipework is limited to legs down with isolation valves. Includes land purchase, reinstatement of land, footpath and roads included. **Unit costs exclude:** New lengths of mains
District Governor Non-ERS IP Inlet	Replace	£0.141	
District Governor Non-ERS MP Inlet	Replace	£0.126	
District Governor Decommissioned	Remove	£0.007	**Unit costs include:** Isolate, disconnect and safely remove and dispose from site District Governor. Works include all labour plant, equipment and materials to carrying out all lifting operations, transport away, breaking up of bases where necessary and removal and disposal off site, ensuring mains are left safe, reinstatement to match surrounding area where ground is not to receive permanent structure.
District Governor Capacity	Replace	£0.064	**Unit costs include:** design, procurement, construction, commissioning and NGN overheads. Weighted average of the unit costs for the following work types - trim DG pressures, pipe laying reinforcement, DG stream swap, DG replacement (existing site), DG replacement (new site).
District Governor Cathodic Protection	Replace	£0.012	**Unit costs include:** design, procurement, construction, commissioning and NGN overheads. Provide new or relocating existing cathodic protection to pipework including M28 test post and concrete base, cabling and connection to pipework, and cabling to anodes.
Service Governor - Domestic	Replace	£0.002	**Unit costs include:** design, procurement, construction, commissioning and NGN overheads. Provide and install service governor and all associated equipment. Provide skid mounted governor designed to comply with TD/13 and GIS34, and lift, fix to floor and pipework. Skid comes complete with all valves and flow control and vent pipe up out of the cabinet. A cabinet is provided over the governor and fixed down and grouted where necessary. Pipework will be legs down with isolation valve only. Connection to mains to be carried out by others. Reinstatement of land, footpath and roads should be included in this Unit Cost Element.
Service Governor - I&C	Replace	£0.029	

8. Business Case Outline and Discussion

8.1. Key Business Case Drivers Description

The below analysis relates to investment on District Governors, including the following categories of spend:

- Civils
- Refurbishment
- Replacement (ERS, IP Inlet, MP Inlet)
- Reinforcement (capacity)
- Decommission

It does not include:

- Service Governors (I&C and Domestic)

- Cathodic Protection (on District Governors)

These have been treated as separate areas of expenditures, predominately as they are either in a separate secondary asset health category or not included in the NARMs models. Both these areas of expenditure are below Ofgem's pre-agreed materiality threshold and as such a CBA has not been included in this paper.

Stage 1 – Individual Asset Class Optimisations

Workload outcomes

Option	Description	No. of Replacements	No. of Refurbishments	No. of Housing Replacements	No. Decommissioned	Capacity Governor Interventions (Reinforcement)	**Total Workload**
-	Baseline	0	0	0	0	0	**0**
1	Reduce Supply Interruptions by 25%	22	15	38	5	34	**114**
2	Reduce Supply Interruptions by 50%	40	25	75	10	68	**218**
3	Reduce Supply Interruptions by 75%	94	32	83	15	68	**292**
4	Reduce Supply Interruptions by 95%	89	42	107	20	68	**326**

As each subsequent option targets a greater risk reduction, a greater number of interventions are proposed. In RIIO-1 we are forecasting an average annual replacement of 8 District Governors for either asset health or third-party reasons such as land issues. This equates to less than 2% of the total population. Option 2 aligns closely with the intervention rates we are seeing in RIIO-1, where as Option 1 is only around half the volume and Options 3 and 4 are over double the number.

It is important to consider our RIIO-2 Maintenance strategy when determining the most appropriate capital replacement strategy. In RIIO-2 we are planning to increase our reactive maintenance both repairing governor paintwork and repairing the buildings which house them. By investing to protect the assets, we will slow deterioration and delay early replacement. As explained earlier, it is generally considered that our District Governor assets are robust, and we are not seeing increasing trends in faults. By managing these assets from an operational perspective, even though many of the asset are over 40 years old and will be another 5 years older by the end of RIIO-2, we should not need to change our RIIO-1 capital replacement strategy. Therefore Option 2 is the most appropriate strategy proposed.

Recent surveys have highlighted significant condition issues with the District Governor housing which is leading to increased Health and Safety risk and faster deterioration of the assets they are housing. Investment now in the governor housing will provide long term benefits for our customers by prolonging the life of our District Governors thereby avoiding early and expensive replacement programmes. During RIIO-1 we are seeing an increasing trend in the numbers of housing replacements we are undertaking and by the end of RIIO-1 we are forecasting an average of 22 per year. Option 4 therefore aligns most closely with our current run rates, however Options 2 and 3 are not far off with 15 or 17 per year respectively. However, like the governor interventions, we need to consider our RIIO-2 Maintenance strategy. This strategy aims to increase reactive maintenance on our governor housing population which should lead to fewer buildings needing replacement. Accounting for our Maintenance strategy Options 2 or 3 seem the most appropriate capex strategies.

Since we are not expecting any significant changes in the way we plan to manage our District Governor assets in RIIO-2 the most appropriate way to forecast the number we will decommission is to look at history. During RIIO-1 although the numbers vary between years, on average over the period we will decommission on average 2 per year. Considering the low numbers, we expect this to

be a consistent figure. Again Option 2 follows history where as Option 1 only forecast 1 per year and Option 3 and 4 forecast 2.5 and 3 per year.

We have identified 68 District Governors which will be over capacity in RIIO-2. As the driver for intervention on these governors is to increase capacity, they are considered part of our Reinforcement strategy (see Reinforcement Investment Decision Pack A23.E for further information). Option 1 considers intervention on half of the assets whereas Options 2, 3 and 4 consider intervention on all 68 over capacity governors. This will be because of the risk benefit delivered through removing the capacity flag within our models.

Objective Outcomes

Option	Description	Total NPV Compared to Baseline at 2070 (£m)	Objectives			
			Total Risk change from 2021	RIIO-2 Annual Cost (£m)	Supply Interruption change from 2021	Payback (years)
-	Baseline	-£311.1	4%	£0.0	0%	-
1	Reduce Supply Interruptions by 25%	£47.5	-27%	£1.2	-20%	1
2	Reduce Supply Interruptions by 50%	£63.3	-37%	£2.2	-35%	1
3	Reduce Supply Interruptions by 75%	£78.5	-52%	£3.7	-71%	1
4	Reduce Supply Interruptions by 95%	£76.0	-52%	£4.4	-88%	1

Within our Decision Support Software, we set our constraints on Supply Interruptions as this will directly benefit our customers and closely links to the total risk.

The first objective was to reduce total risk to a level below the starting point of RIIO-2. All options propose deliver against this objective which proves that our investments will deliver value for money for our customers. As expected as each option progressively improves the level of supply interruptions, risk follows a similar path.

Our second objective was to ensure efficient costs, Option 4 is the highest cost option as it delivers the best risk and service levels and fails to meet this objective resulting in double the capital cost per year in RIIO-2. Option 3 improves on this slightly but still fails this objective with a 68% annual increase. Options 1 and 2 meet this objective. Option 2 equals RIIO-1 costs which supports the workloads discussed above closely aligning with RIIO-1 volumes. Option 1 improves on this objective and proposes a 48% reduction when compared to RIIO-1 averages.

Our third objective was focussed on improving the current levels of service which has been measured by looking at the expected number of supply interruptions. As we used this service measure as the primary constraint within our Decision Support Software to develop the options, we have predetermined the results of this objective. Since we were able to reduce supply interruptions with a lower annual average spend than in RIIO-1 each subsequent option considers a higher service improvement.

All options payback within one year and therefore all pass this objective and represent a worthwhile investment that provides benefit to our customers and reduces the risk of asset stranding. The short time in which the options payback is partly due to the overcapacity governors which have a higher likelihood of failure, but also because of the high consequence of failure due to customer numbers compared to relatively low intervention costs. Option 3 has the highest Net Present Value at 2070 which would be considered near or end of life, closely followed by Option 4. Option 2 has the third highest NPV with Option 1 the lowest.

Conclusion

Option 2 has been chosen as it delivers against all our four objectives and proposes a consistent workload and spend with what we have delivered in RIIO-1.

Options 3 and 4 have been discounted due to their significantly higher capital expenditure forecasts which considering the increase in Maintenance in RIIO-2 does not represent value for money for our customers. Option 1 has been discounted due to the NPV. The NPV for this option demonstrates the significantly lower value that this option generates for the customers. Although this has a lower capital expenditure amount, the value delivered for customers is significantly worse. Therefore, we do not believe this is an appropriate option.

Stage 2 – Individual Asset Class Sensitivity Analysis

Objective Outcomes

Option	Description	Total NPV Compared to Baseline at 2070 (£m)	Objectives			
			Total Risk change from 2021	RIIO-2 Annual Cost (£m)	Supply Interruption change from 2021	Payback (years)
2	Reduce Supply Interruptions by 50%	£63.3	-37%	£2.2	-35%	1
5	Pre-emptively Replace Only	£63.1	-40%	£3.1	-35%	2
6	Pre-emptively Refurbish Only	£12.1	-4%	£0.6	-6%	5
7	Deferred Investment	£10.1	4%	£0.0	0%	12

Option 5 provides only a marginal improvement in both the risk position and the reduction in number of supply interruptions, however it comes at an increased cost of £4.3m. The results of this are also reflected in the NPV calculation, which shows this option has a lower NPV than Option 2, further emphasising that Option 2 provides more value to our customers over the long term. A replacement only strategy does not align with our approach to maximise the value of our existing assets and the cost of this option is prohibitive in accepting this as our preferred RIIO-2 plan.

Option 6 proposes an £8m cost saving when compared to Option 2 however it does this at detriment to both risk and service levels which have both worsened by 88%. This is demonstrated by the significantly lower NPV compared to the other options and therefore offers the least value to our customers. Although a refurbishment strategy aligns with our approach to maximise the value of our existing assets, this analysis shows that for certain assets we cannot deliver improvements to our service levels without allowing some assets to be replaced. In addition, engineering issues such as severe corrosion or capacity constraints and legal issues such as easement disputes are not always solvable through a refurbishment option and therefore an option which allows for no asset replacements is unrealistic.

Option 7 defers capital investment until RIIO-3 and so delivers the baseline level of risk and supply interruptions during RIIO-2 which is a significant increase in both when compared to Option 2. The payback and NPV demonstrate that this option still adds value to the customer so is a viable option, however both the payback and NPV are lower than the other options considered and as such this option does not provide as much value as the preferred option, or other options considered. This option conflicts with our stakeholder feedback on safety and reliability and does not represent good asset management for our customers and therefore is not considered an improvement on Option 2.

Conclusion

Option 2 remains our preferred option as the sensitivities undertaken have not been able to better the overall position considering all objectives. District governors are one of our largest asset classes, by number of assets, and we believe that these assets require continual investment to prevent a long-term build-up of risk to reduce the chance of a large-scale replacement programme in the future, which would ultimately cost the customers significant sums of money.

We have identified as part of this exercise that by maintaining our investment (as per Option 2), we can significantly reduce (by 35%) the predicted number of service interruptions that district

governors produce by targeting that investment at the highest risk assets and with interventions that target Customer risk.

Other Minor Investments

- **Service Governors** – We have modelled the impact of service governors failing through our value framework however as these assets tend to only supply one customer the risk associated with them is less than the cost of replacing the asset. Therefore, this means investment to replace failed assets does not payback in the life time of the asset. However regardless of this, to ensure we maintain our license obligation for continuity of supply we must replace these assets when they fail. We have used historic failure rate trends to determine our strategy for RIIO-2. During RIIO-1 we experienced a small number of Service Governor failures each year and our proposal for RIIO-2 is that this failure rate will continue, and we will replace the assets on failure. This equates to less than £200k per year.

- **Cathodic Protection** – During RIIO-1 we have had a programme of upgrading cathodic protection on district governors when the systems fail. This strategy has been successful and will result in no non-compliant systems at the end of RIIO-1. As Cathodic Protection is not modelled as a primary or secondary asset within NARMs we propose to continue our RIIO-1 strategy of replacement on failure during RIIO-2 to ensure our cathodic protection systems remain compliant and our assets are protected. The benefit of this work is reduction in health and safety risk, customer risk and cost avoidance as corrosion to the inlet and outlet steel pipework of a district governor would require excavation and replacement. Our workload is based on RIIO-1 run rates as we do not envisage any significant differences between the two price control periods.

8.2. Business Case Summary

As per the agreed cost benefit analysis framework, total costs and risk under each of the options is compared to the total costs and risk under the baseline, as measured by the NARMs models.

The table below details the headline business case metrics to allow a high-level comparison of the options:

Option	Description	No. of Assets Impacted	Capex RIIO-2	Total NPV compared to baseline (£m)	Payback (years)	Change in Total Risk (from 2021)	Change in SI (from 2021)	Preferred Option
-	Baseline	0	0	-	-	4%	0%	N
1	Reduce Supply Interruptions by 25%	114	£5.9	£47.5	1	-27%	-20%	N
2	Reduce Supply Interruptions by 50%	218	£11.0	£63.3	1	-37%	-35%	Y
3	Reduce Supply Interruptions by 75%	292	£18.6	£78.4	1	-52%	-71%	N
4	Reduce Supply Interruptions by 95%	326	£22.2	£76.0	1	-52%	-88%	N
5	Pre-emptively Replace Only	218	£15.4	£63.1	2	-40%	-35%	N
6	Pre-emptively Refurbish Only	218	£3.0	£12.1	5	-4%	-6%	N
7	Deferred Investment	0	£0.0	£16.9	12	4%	0%	N

9. Preferred Option Scope and Project Plan

9.1. Preferred Option

- **District Governors** - The preferred option is Option 2 – Reduce supply interruptions by 50%.
- **Service Governors** – The preferred option is RIIO-1 run rates.
- **Cathodic Protection** – The preferred option is RIIO-1 run rates.

9.2. Asset Health Spend Profile

The table below details the preferred option's intervention workloads and capital expenditure forecasts for RIIO-2:

Asset Class	Intervention	Workload	Unit	Capital Expenditure (£m) 2018/19 prices					
				2021/22	2022/23	2023/24	2024/25	2025/26	Total
District Governor - Housing	Replace	75	Asset	£0.2	£0.2	£0.2	£0.2	£0.2	**£1.0**
District Governor	Refurbish	25	Asset	£0.1	£0.1	£0.1	£0.1	£0.1	**£0.4**
District Governor (IP inlet)	Replace	5	Asset	£0.1	£0.1	£0.1	£0.1	£0.1	**£0.7**
District Governor (MP inlet)	Replace	20	Asset	£0.5	£0.5	£0.5	£0.5	£0.5	**£2.5**
District Governor - ERS (MP inlet)	Replace	15	Asset	£0.5	£0.5	£0.5	£0.5	£0.5	**£2.3**
District Governor	Decommission	10	Asset	£0.0	£0.0	£0.0	£0.0	£0.0	**£0.1**
District Governor Subtotal	-	**150**	-	**£1.4**	**£1.4**	**£1.4**	**£1.4**	**£1.4**	**£7.0**
Service Governor (Domestic)	Replace	420	Asset	£0.1	£0.1	£0.1	£0.1	£0.1	**£0.7**
Service Governor (I&C)	Replace	5	Asset	£0.0	£0.0	£0.0	£0.0	£0.0	**£0.1**
Service Governor Subtotal	-	**425**	-	**£0.2**	**£0.2**	**£0.2**	**£0.2**	**£0.2**	**£0.9**
District Governor Cathodic Protection	Replace	25	System	£0.1	£0.1	£0.1	£0.1	£0.1	**£0.3**
Other Capex Subtotal	-	**25**	-	**£0.1**	**£0.1**	**£0.1**	**£0.1**	**£0.1**	**£0.3**
District Governor Capacity (Specific Reinforcement)	Various	68	Asset	£1.0	£0.8	£0.8	£0.8	£0.6	**£4.0**
Reinforcement Subtotal	-	**68**	-	**£1.0**	**£0.8**	**£0.8**	**£0.8**	**£0.6**	**£4.0**
Grand Total	-	**668**	-	**£2.6**	**£2.5**	**£2.5**	**£2.5**	**£2.2**	**£12.2**

The total forecast capital expenditure for District Governors has been included within this Cost Benefit Analysis and can be referenced back to the following documents:

- RIIO-2 Business Plan – Tables 6.5, 6.6 & 6.8
- RIIO-2 Business Plan Data Tables – Table 3.02, 3.03 & 3.05
- A23.H - NGN RIIO-2 Investment Decision Pack – Governors - CBA

9.3. Investment Risk Discussion

We have controls and processes in place throughout the development of our RIIO-2 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 NARMs methodology to calculate individual asset's Probability of Failure which uses asset attributes to determine specific failure rates.
- We have undertaken recent surveys during 2019 on half of our governor sites. This latest information has been used within our modelling.
- As most of our governors installed on our network are from one manufacturer, Donkins, we have not witnessed 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.

- We have sense checked our preferred option against other asset data such as age, condition surveys, fault trends.
- We have shared our preferred strategy with our businesses industry experts to sense check volumes and costs.
- Our RIIO-2 strategy is comparable with our RIIO-1 strategy and so we have a proven record we can manage our assets in this way.

Unit Cost Risk Mitigations

- We have used our Unit Cost Database to determine our unit costs. This database holds c.17,000 datapoints which have been collated in a consistent way to ensure our historic costs accurately inform our RIIO-2 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 Database.
- We have benchmarked our unit costs against other GDN's to ensure our unit costs are efficient.
- 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.