Appendix 09.31:
Strategic Pipeline Isolation Valves <7 bar
Strategic MP/IP (M1) Valves

RIIO-2 Spend: XXXX

Investment Decision Pack Overview

This Asset Health Engineering Justification Framework outlines the scope, costs and benefits for our proposals. As this work is safety mandated, we have not developed a cost-benefit analysis (CBA).

Overview

Cadent has 5,670 Strategic Pipeline Isolation Valves operating at <7 bar (SPIV).

These valves are a critical safety feature within our distribution network and allow us to isolate specific areas in case of a pipeline failure, or to deliver maintenance work.

They ensure Cadent's compliance with Pipeline Safety Regulations (PSR) 1996 – in particular Regulation 6 and Regulation 13.

These valves were installed when the pipeline was originally constructed up to 40 years ago and have had limited remediation since. However, we are now seeing indications through surveys of issues with these ageing assets. Our visual inspection program during RIIO-1 has raised issues around valve access and operability – in response we have undertaken interventions in RIIO-1 including rebuilding chambers which have collapsed following third-party work, reinstating pressure points which have aged or been damaged and more comprehensive interventions to fully refurbish valve units. In total we have remediated around 26% of the SPIVs asset base. We have also recorded that a number of valves have been buried as a result of roadworks or other land changes. We are now beginning a programme of more detailed survey work including excavation of buried assets to better understand these issues, this work will continue into RIIO-2.

These more detailed investigations, and excavation, will identify the need for further interventions – similar to those in RIIO-1, to maintain compliance.

Individual valve interventions will be specific to the failures identified. However at a program level we have considered options around the rate of survey and intervention to ensure compliance. This analysis hinges on what is a reasonably practicable rate of investment delivery:

- Baseline: Fix the valve upon pipeline failure or when it is required for planned work.
- Option 1: Remediate all deficient valves during RIIO-2 and 3 (10-year program)
- Option 2: Remediate all deficient valves during RIIO-2 (5-year program)

Within option 1 and 2 we would prioritise intervention based on valve criticality.

Option 1 is the reasonably practicable programme option. The Baseline is not compliant with legislation and Option 2 is not deliverable within a 5 year period. The chosen option is a 10-year proactive programme of valve remediation work prioritised based on consequence of failure.

Given experience gained during RIIO-2 we are confident that the program can be efficiently delivered within the period. Ensuring that when our SPIVs are required they can be located easily and will operate as per their design.

Summary of preferred option	XXXX
RIIO-2 Expenditure	XXXX
NPV	N/A

Material Changes Since October Submission

There have been no material changes since October.

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2. Introduction

This document covers investment in Strategic Pipeline Isolation Valves operating at <7 bar (SPIV). A SPIV is one that is deemed to isolate flows in excess of 7,500 m^3/hr (which is equivalent to providing gas to 7,500 domestic customers) or those that are on pipelines 12" or above in diameter.

Cadent has 5,670 SPIVs on the MP and IP network.

These valves are a critical safety feature within our distribution network and allow us to isolate specific areas in case of a pipeline failure, or to deliver maintenance work.

They ensure Cadent's compliance with Pipeline Safety Regulations (PSR) 1996 – in particular Regulation 6 and Regulation 13.

These valves were installed when the pipeline was originally constructed up to 40 years ago and have had limited remediation since. However, our survey programme is now recording indications of deterioration in the ageing assets. Our visual inspection program during RIIO-1 has raised issues around valve operability and accessibility – in response we have undertaken interventions in RIIO-1, including rebuilding chambers which have collapsed following third-party work, reinstating pressure points which have aged or been damaged and more comprehensive interventions to fully refurbish or replace valve units. In total we have remediated around 26% of the SPIVs asset base. We have also recorded that a number of valves have been buried as a result of roadworks or other land changes.

We are now beginning a programme of more detailed survey work including excavation of buried assets to better understand these issues. This will allow us to identify and respond to any non-compliances.

We have not used CBA to inform our valve investment case, recognising that we have a critical safety mandate to ensure that suitable isolation valves are provided to protect our employees and the public from gas escapes in the event of an emergency. The probability of an emergency event (i.e. loss of life and property due to a gas escape) is low, but the consequence of such an event is very high for these major pipelines.

This is an ongoing programme of work to ensure compliance i.e. that our valves would, in the case of an incident be able to effectively isolate the network as per their design.

3. Equipment Summary

The equipment covered by this investment case is SPIVs operating at <7 bar. These are valves deemed to isolate flows in excess of 7,500 m³/hr (which is equivalent to providing gas to 7,500 domestic customers) or those that are on pipelines 12" or above in diameter. In practice, all IP valves are SPIVs with around 17% of MP valves also being classified as strategic.

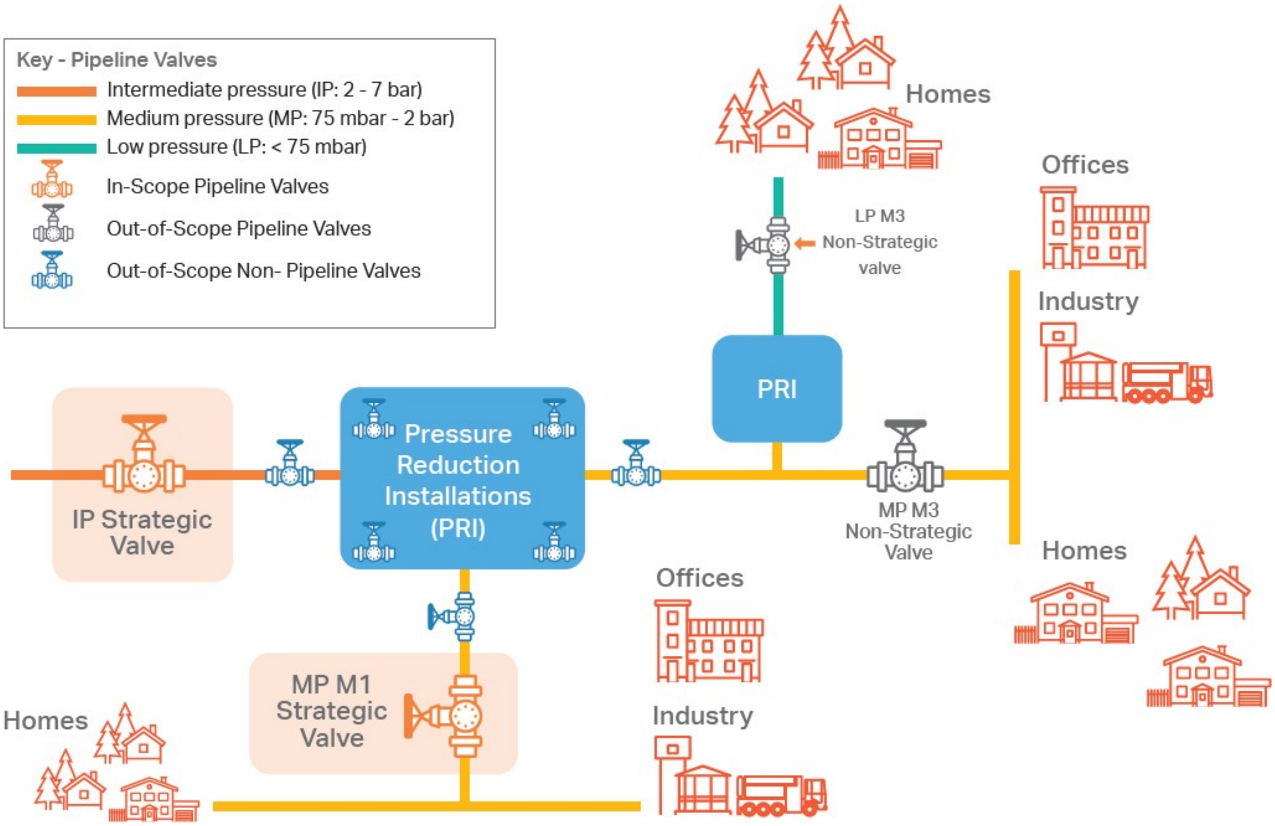

Figure 1: Pipeline isolation valves included within this investment case

Figure 1, above, shows a simplified version of the below 7 bar distribution network. Only the SPIVs (classified internally by Cadent as M1 valves) are in the scope of this investment paper.

The table below provides a per-network split of SPIVs across the IP and MP pressure tiers:

Network	IP SPIVs (2 – 7 barg)	MP SPIVs (75 mbarg to 2 barg)	Total
EoE	1,144	1,049	**2,193**
Lon	83	363	**446**
NW	889	1,138	**2,027**
WM	368	636	**1,004**
Total	**2,484**	**3,186**	**5,670**

Table 1: Asset stock of SPIVs by pressure tier

From within this overall asset base of SPIVs, we have carried out (or plan to carry out during the remaining RIIO-1 period) interventions on 1,080 MP SPIVs and 407 IP SPIVs. This intervention plan was agreed with

Ofgem during RIIO-1. We have targeted RIIO-1 interventions at the valves that were most strategically critical and have also considered valve condition within this prioritisation.

Table 2 gives the population of the remaining un-remediated valves, which has been tested under the various intervention options for RIIO-2 and RIIO-3. The 'Remediation Target' column in the table below provides the population set that formed part of our RIIO-1 settlement.

Network	Total IP Population	RIIO-1 IP Remediation Target	Un-remediated IP Population by the end of RIIO-1	Total MP (M1) Population	RIIO-1 MP (M1) Remediation Target	Un-remediated MP Population by the end of RIIO-1
EoE	1,144	168	976	1,049	394	655
Lon	83	4	79	363	123	240
NW	889	172	717	1,138	360	778
WM	368	63	305	636	203	433
Total	**2,484**	**407**	**2,077**	**3,186**	**1,080**	**2,106**

Table 2: Population of valves not remediated in RIIO-1

4. Problem Statement

What is the outcome that we want to achieve, why are we doing this work and what happens if we do nothing

We want to ensure that our network is safe to operate, specifically that we comply with the requirements of PSR '96. This means that in the event of an incident, such as that described below, we are able to easily locate our SPIVs and that they will operate as per their design, allowing us to manage the incident.

The investment in remediating and maintaining SPIVs will ensure that our network can be safely and effectively operated and has appropriate safeguards in place in the event of an emergency gas escape or an operational emergency. Investment will allow us to reliably isolate key areas of the gas-network, to limit the uncontrolled release of gas and the related risk of fire or explosion.

Failure to have a programme of work in place to ensure compliance may lead to enforcement from the HSE. Although a non-compliant valve in itself does not present an immediate hazard, a pipeline failure cannot be effectively controlled without operational valves.

If the closest valve is not operational the next operational valve in the line may be used (or an excavation and flow stop operation conducted – a 'stopple'), however this delays the time taken to isolate and also widens the impact of the event (potentially cutting off more customers).

How will we understand if the spend has been successful

We will be able to provide detailed current survey reports for each of our SPIVs recording that they are accessible and operable. As such we would be confident that our SPIVs can be located and will operate as designed in the case of an emergency or to support proactive maintenance work.

Investment Drivers

1,487 (26%) of our 5,670 SPIVs will have been intervened on during RIIO-1, leaving 4,183 valves for future interventions.

SPIVs are used infrequently but it is critical that they function reliably in the event of an emergency, to protect the safety of our employees, the general public and customers. An uncontrolled gas escape, through the lack of effective isolation, is unacceptable.

Pipeline Safety Regulations are clear on operators requirements, these are absolute duties.

Pipeline Safety Regulations (PSR – 1996)	HSE Guidance
Regulation 6 Safety systems "The operator shall ensure that no fluid is conveyed in a pipeline unless it has been provided with such safety systems as are necessary for securing that, so far as is reasonably practicable, persons are protected from risk to their health or safety."	The pipeline should be provided with such safety systems, as necessary, to protect people from risk. Safety systems cover means of protection such as emergency shut-down valves and shut-off valves which operate on demand or fail safe in the closed position, so minimising loss of containment of the pipeline inventory.

Regulation 13 Maintenance "The operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair."	This regulation deals with the requirement to **maintain the pipeline to secure its safe operation** and to prevent loss of containment. Maintenance is essential to ensure that the pipeline remains in a safe condition and is fit for purpose. It is important to recognise that a **pipeline includes associated equipment such as valves**, bridles and other primary attachments. It may also include launch and reception pig traps. These should be maintained, as necessary, to ensure that they are kept in efficient working order. Maintenance under this regulation also includes maintaining any safety system associated with the pipeline which has been provided to secure its safe operation.

Table 3: Extracts from HSE publication: A guide to the Pipelines Safety Regulations 1996 (ISBN: 9780717611829)

4.1. Narrative Real-life Example of Problem

4.1.1 San Bruno, California Pipeline Explosion:

In 2010, a pipeline explosion within Glenview residential area of San Bruno in California resulted in the death of eight people. The incident was caused by an unmanaged welded seam defect on a 30-inch gas pipeline, which caused the pipeline to rupture and explode. The incident resulted in over $4.2 billion in losses for PG&E in compensations and federal and state penalties.

After PG&E received calls about the fire, they dispatched technicians, who closed the upstream, and downstream valves, which were both located approximately 1 mile away from the rupture. This was the first response from the network operator.

In this case the valves were easy to locate and operable. However, PG&E still took 95 minutes to stop the flow of gas and to isolate the rupture site. This response time was considered by subsequent formal investigations as 'excessively long'. It contributed to the extent and severity of property damage and increased the life-threatening risks to the residents and emergency responders. The fire continued its devastation of the neighbourhood area and killed 8 people, injured 66, damaged or destroyed 55 homes and consumed 15 acres of land.

Figure 2: Images from San Bruno, California pipeline explosion incident

If the valves had not been operable and a wider shut had been required or an excavation was needed to deploy a stopple the situation would have been even worse. The case shows the absolute criticality of having pipeline valves that are quickly and easily accessible and operable so that any emergency incidents like this can be contained as soon as reasonably practicable.

If valves are not accessible, for instance, due to being tarmacked over or overgrown with vegetation, that will add time to locate and access them. If then they are found to be inoperable from the surface, excavation will be carried out which normally will be a deep excavation for IP and MP valves and will require appropriate deep excavation management procedures to ensure the safety of operatives. If the valve is found to be ceased or inoperable upon access, the pipeline will then need to be physically disconnected by bagging off or stopple operations which are carried out by specialist contractors. Every added minute could mean an increased risk to life and property and therefore we intend to assure ourselves through this investment proposal that we have appropriate plans in place for maintenance of our SPIVs.

4.1.2. Valve Remediation on Silfield to Kilverston Pipeline Valve:

In 2012, we recorded one valve failure where valves were needed to contain an emergency and they were found to be both inaccessible and inoperable.

The Silfield to Kilverston 19-bar pipeline (pipeline ID number 1641), operated by Cadent, was damaged by a third party ploughing a previously uncultivated section of a field in 2012. The pipeline was punctured allowing the subsequent release of gas.

The valves required to isolate the pipeline section were quickly identified. They were marked on plans and known to the local manager. However, the teams arriving on site found that the main line valves were not all clearly marked and accessible for operation. The pressure points, which allow an operator to confirm that a valve has sealed and shut the pipeline, where also in poor condition.

Due to the inability to access the valves and pressure points, external contractor teams with the specialist mechanical excavation equipment were called in to do this emergency work. This caused a delay of nearly 24 hours to isolate the pipeline. Fortunately, this was a remote rural location, where the exclusion area around the damage and escaping gas was easily managed.

This incident provided us with a lagging indicator of failure, where the asset had failed, and the consequences were realised. In this case the impact was low due to it being a remote rural area.

4.2. Spend Boundaries

The equipment covered by this investment case is SPIVs operating at <7 bar. These are valves deemed to isolate flows in excess of 7,500 m^3/hr (which is equivalent to providing gas to 7,500 domestic customers) or those that are on pipelines 12” or above in diameter. In practice, all IP valves are SPIVs with around 17% of MP valves also being classified as strategic.

All valves which do not fall under this definition are excluded from the scope of this paper. This includes above ground valves (non-pipeline valves) found at our Pressure Reduction Installations (PRI) and associated site isolation valves. Also excluded are the 3,067 HP pipeline valves (covered by Uncertainty Mechanism Appendix 10.15), the 16,097 non-strategic MP valves (M3 valves), and all LP valves. We have not developed a proactive strategy on any SPIVs that may be found within the LP distribution network, however, all these descoped valves will continue to receive their routine scheduled maintenance visits and any immediate risks or failure will be dealt with on a fix-on-fail basis.

It also excludes Intervention on a valve includes maintenance of its pressure points, rider points, valves plates, turning mechanism and its chamber and lid.

5. Probability of Failure

We have recorded valves failing to operate when required during RIIO-1.

We have also identified valves which appear to be inoperable or inaccessible – these valves have a high likelihood of failure if required for operation. They may be buried, have failed mechanisms, or absent pressure points so that a full shut cannot be confirmed. Without further work to confirm condition and/or mitigate these risks, the likelihood for failure remains high.

Based on the results of our visual valve inspection programme during RIIO-1, we are aware that our SPIVs valves have potential deficiencies (of differing types), which would prevent them from being 'accessible and/or operable' to enable isolation of the pipeline. During RIIO-1 we are remediating the highest criticality valves.

Our leading indicator is compliance with the PSR '96, Regulation 13 which states: *"the operator shall ensure that a pipeline is maintained in an efficient state, in efficient working order and in good repair."* We operate a valve maintenance regime to discharge our obligations under this regulation. In RIIO-1, following successful completion of our latest survey programme, we have been able to identify details for all our SPIVs and have been able to deliver targeted interventions to the most critical valves within our population. To ensure that our population of strategic valves is maintained in an operable state and in good working order, we are proposing that in addition to ongoing visual inspections we deliver a more intrusive survey and intervention regime in RIIO-2 for the un-intervened valves.

Where a chamber does not exist (or a valve has become buried), assurance of compliance can only be gained through excavating the valve, analysing its physical condition and ensuring access and operably are maintained.

From our experience of remediating these valves in RIIO-1, it is anticipated that the required interventions will vary from valve to valve in regards complexity (and cost) of resolving observed issues. Therefore, each valve has been allocated an expected complexity based on the survey results; which we can translate into 'high', 'medium' or 'low' unit cost.

This breakdown is provided in tables below for MP and IP SPIVs respectively, complexity reflects observed condition and as such likelihood of failure:

MP Valves Intervention Complexity Analysis for Remaining Population			
Probability of failure increases			
Network	Low Complexity % Population	Medium Complexity % Population	High Complexity % Population
EA	33%	36%	31%
EM	28%	41%	31%
Lon	34%	16%	50%
NW	21%	26%	53%
WM	39%	28%	33%

Table 4: MP Valves Intervention Unit Cost Range

IP Valves Intervention Complexity Analysis for Remaining Population			
Probability of failure increases			
Network	Low Complexity % Population	Medium Complexity % Population	High Complexity % Population
EA	13%	10%	77%
EM	19%	10%	71%
Lon	30%	40%	30%
NW	14%	8%	78%
WM	37%	14%	49%

Table 5: IP Valves Intervention Unit Cost Range

5.1 Probability of failure data assurance

A valve is defined to have failed the visual assessment, if at least one of the criteria below is fulfilled:

- Safe access is not available
- Operability is not verifiable
- Physical surface condition is unacceptably poor or not determined
- Appropriate equipment for safe and efficient operation of valve not present (including rider and pressure points either side of the valve, valve pit and chamber, lid and marker plates)

We have recorded a variety of failures within our RIIO-1 survey programme and intervened on the highest risk failures on most critical valves serving a high population of our customers. Within the remaining population, our survey results indicate a similarly varied level of failure complexity as per tables 3 and 4 above.

Our surveys inform us that within the un-intervened population 71% of our MP and 80% of our IP SPIV population fall within the Medium or High complexity interventions. The remaining 29% MP and 20% IP population falls within the Low complexity intervention category. Table below breaks down the remaining un-remediated valve population in to these complexity ranges:

Complexity Levels in Remaining MP SPIVs			
Network	**Low**	**Medium**	**High**
EA	100	109	94
EM	72	106	80
Lon	94	44	139
NW	162	200	408
WM	166	119	140
Total	**594**	**578**	**861**
Proportion	29%	28%	42%

Table 6: MP interventions complexity levels

Complexity Levels in Remaining MP SPIVs			
Network	**Low**	**Medium**	**High**
EA	79	61	469
EM	80	42	297
Lon	24	32	24
NW	102	58	567
WM	179	68	237
Total	**463**	**260**	**1594**
Proportion	20%	11%	69%

Table 7: IP interventions complexity levels

These categories are described as follows:

High Complexity:

This is where the valve is either completely buried with no access chambers for the valve and/or the pressure and rider points upstream and downstream of the valve. These are where excavation is inevitable to accurately locate the valve and the pressure and rider points and thereafter, depending on their condition these assets are replaced or refurbished. Appropriate chambers and lids are then installed for ease of future access. Considerable excavation (typically deep excavation requiring appropriate shuttering for safe working) and traffic management is usually linked to this complexity level.

Medium Complexity:

Valves under this category are where the survey results indicate only some of the pressure and rider points being accessible. This complexity level also requires excavation to locate and refurbish the inaccessible assets and installation of appropriate chambers for them

Low Complexity:

Valves in this category are where all the lids for the valve and its pressure and rider points are visible. However, intervention is still required on these to ensure refurbishment of lids, marker plates, chambers etc and an assurance on the operability and accessibility of the valves, pressure points and rider points. These refurbishment and assurance activities are essential toward ensuring our compliance with PSR '96 – Regulation 13. Low complexity jobs are also low cost.

This plan is based on known issues identified during RIIO-1 survey programme which require intervention. We, therefore, have a high level of confidence that the failure rates and complexity levels are accurate.

6. Consequence of Failure

A failure of a strategic isolation valve has no immediate impact on Cadent's operations. The impact will materialise when a gas escape is detected, which then relies on the failed valve for isolation or when the valve is required to enable maintenance activities. However, any failed asset does constitute a breach of Pipeline Safety Regulations.

Cadent's comprehensive programme of asset inspection and maintenance across its pipelines means that the probability of a gas escape on these protected pipelines is low. However, as we have seen in our real life example the consequences are potentially large.

The failure of the SPIV, combined with an operational emergency, can have the following consequences:

- **Safety impact** from the failure: the gas escape or damage from an ongoing fire would be increased in duration.
- **Loss of supply to a greater number of customers**: the use of a different valve further upstream or gas isolation at the upstream PRI within the network would be required, potentially causing supply interruptions to a greater number of customers.
- **Environmental damage:** the delay in providing effective isolation, would lead to an increase in released methane gas, subsequently increasing the environmental damage.
- **Significant costs to deal with the emergency:** if a SPIV was inoperable, the business would need to mobilise resources (generally expensive specialist teams) to then carry out an emergency stopple on the pipe, which involves a complete excavation around the pipe and physical insertion of air bags within the pipeline to temporarily stop the flow.

7. Options considered

Individual valve interventions will be specific to the failures in compliance identified. However at a program level we have considered options around the rate of survey and intervention to ensure compliance. This analysis hinges on what is a reasonably practicable rate of investment delivery:

- Baseline: Fix the valve upon pipeline failure or when it is required for planned work.
- Option 1: Remediate all deficient valves during RIIO-2 and 3 (10 year program)
- Option 2 Remediate all remaining valves during RIIO-2 (5 year program)

Within option 1 and 2 we would prioritise intervention based on valve criticality.

7.1 Baseline: Fix the valve upon failure

This option is the 'do-minimum' or baseline case. In this scenario we would stop survey and maintenance activity on our SPIVs or continue survey work but take no corrective action. This would allow issues to develop, un-remediated, on our SPIVs. When the valve is required to shut the pipeline for either maintenance or under emergency circumstances we would then intervene to make repairs.

The likelihood of a gas escape on a strategic gas pipeline is low in view of the several layers of pipeline protection provisions (including, but not limited to pipeline coating, cathodic protection, line walking and aerial surveillance). However, the impact is potentially very high as outlined above.

This option, although lower cost in the short term does not deliver the safety standards our customers or regulators expect and has therefore been discounted.

7.2 Option 1 & 2: Proactively inspect and remediate the valves

Our visual surveys of SPIVs, undertaken during RIIO-1, identified various non-compliances within the asset portfolio (such as missing pressure and rider points). Through the visual surveys, we have been able to categorise the interventions required on our SPIVs into Low, Medium or High complexity as previously detailed in Section 5 above. However, the precise scope and scale of non-compliance and the subsequently required intervention will not be clear until more intrusive surveys are carried out on all the valves not remediated within RIIO-1.

The following table shows the population of valves that will still need intervention after completion of the RIIO-1 intervention programme:

Network	Unremediation IP Population by the end of RIIO-1	Unremediation MP Population by the end of RIIO-1
EoE	976	655
Lon	79	240
NW	717	778
WM	305	433
Total	**2,077**	**2,106**

Table 8: Population of SPIVs not remediated in RIIO-1

For RIIO-2 and RIIO-3, we have looked at an appropriate intervention rate which allows us to manage the risk on our most critical valves while being deliverable and affordable to customers.

We have considered two different rates of remediation.

Option 1: Remediating all valves over RIIO-2 and 3

Option 2: Remediating all valves over RIIO-2

Options 1 and 2 Compared to RIIO-1 Intervention Levels	% Remediation per year	
	IP	MP
RIIO-1 Intervention Levels	2%	4%
Option 1: Intervention on all valves over RIIO-2 and 3	8%	7%
Option 2: Intervention on all valves over RIIO-2	17%	13%

Table 9: Annual percentage remediation per annum

Option 2 would not be deliverable operationally and also not affordable to customers as skilled labour at premium prices would need to be employed to cater for such an increase in workload. Excavation around these critical assets and associated maintenance work on SPIVs requires trained engineers working in controlled conditions.

We have therefore developed a workload based on spreading intervention across two price controls whilst delivering remediation to the most-critical valves in RIIO-2, followed by the lower-criticality valves in RIIO-3. The valves not intervened on in RIIO-2 would still receive survey and routine maintenance visits to monitor condition.

The proposed work split for both investment options is shown in Table 10 below.

Investment strategies	Pressure Tier			
	IP		MP	
	% of remaining valves to for intervention	Volume of remaining valves for intervention	% of remaining valves for intervention	Volume of remaining valves for intervention
Option 1				
RIIO-2	65%	1,350	25%	526
RIIO-3	35%	727	75%	1,580
Total		**2077**		**2,106**
Option 2				
RIIO-2	100%	2,077	100%	2,106
RIIO-3	0%	0	0%	0
Total		**2,077**		**2,106**

Table 10: Workload split for both investment options

In Option 1, a higher proportion of IP valves will be remediated in RIIO-2 due to their increased criticality.

This increases the workload by 332% for IP and reduces the MP workload by 49% compared to the RIIO-1 current workload. Overall, this means an increase of 126% in total workload. Although still a challenging target for Cadent, it is right for us to intervene to manage safety.

The following table shows our proposed average annual valve remediation volumes by region throughout RIIO-2 for Option 1.

Distribution Network	Pressure Tier	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	IP	127	127	127	127	127	**634**
	MP	33	33	33	33	33	**164**
Lon	IP	10	10	10	10	10	**51**
	MP	12	12	12	12	12	**60**
NW	IP	93	93	93	93	93	**466**
	MP	39	39	39	39	39	**195**
WM	IP	40	40	40	40	40	**198**
	MP	22	22	22	22	22	**108**
Total	**IP**	**270**	**270**	**270**	**270**	**270**	**1,350**
	MP	**105**	**105**	**105**	**105**	**105**	**526**

Table 11: Option 1: Proposed average annual remediation volumes

Using the unit costs stated in Section 7.1 and the complexity levels stated in

Table 4 and Table 5 of Section 5. Probability of Failure, the following RIIO-2 cost (X) profile is proposed.

Distribution Network	Pressure Tier	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	IP						
	MP						
Lon	IP						
	MP						
NW	IP						
	MP						
WM	IP						
	MP						
Total	**IP**						
	MP						

Redacted due to commercial sensitivity

Table 12: Option 1: Proposed annual intervention costs (X)

The following table shows our proposed average annual valve remediation volumes by region throughout RIIO-2 for Option 2.

Distribution Network	Pressure Tier	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	IP	195	195	195	195	195	**976**
	MP	131	131	131	131	131	**655**
Lon	IP	16	16	16	16	16	**79**
	MP	48	48	48	48	48	**240**
NW	IP	143	143	143	143	143	**717**
	MP	156	156	156	156	156	**778**
WM	IP	61	61	61	61	61	**305**
	MP	87	87	87	87	87	**433**
Total	**IP**	**415**	**415**	**415**	**415**	**415**	**2077**
	MP	**421**	**421**	**421**	**421**	**421**	**2106**

Table 13: Option 2: Proposed average annual remediation volumes

Using the same method as Option 1 to calculate the cost profile of RIIO-2 for Option 2, Table 14 was produced.

Distribution Network	Pressure Tier	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EA	IP						
	MP						
EM	IP						
	MP						
Lon	IP			[redacted]			
	MP						
NW	IP						
	MP						
WM	IP						
	MP						
Total	**IP**						
	MP						

Redacted due to commercial sensitivity

Table 14: Option 2: Proposed annual remediation costs (X)

7.3 Options Technical Summary Table

	Baseline	Option 2		Option 1	
Description	Baseline: Reactive fix of valves, once valves have failed	Proactive remediation of valves that have deficiencies noted from valve surveys: Remediate all in RIIO-2		Proactive remediation of valves that have deficiencies noted from valve surveys: Remediate all in RIIO-2 & 3. (Chosen)	
First year of spend	This option has been discounted because is it critical that we are able to reliably use a SPIV in an emergency; pipeline failure is a low-probability but a very high consequence event.	2021/22		2021/22	
Last year of spend		2025/26		2031 /32	
Volumes of intervention		**RIIO-2**	**RIIO-3**	**RIIO-2**	**RIIO-3**
		IP valves: 2,077 valves **MP valves:** 2,106 valves	**IP valves:** None **MP valves:** None	**IP valves:** 1,350 valves **MP valves:** 527 valves	**IP valves:** 727 valves **MP valves:** 1,580 valves
Equipment design life		Various; dependent on valve remediation required.		Various; dependent on valve remediation required.	
Total installed cost		[redacted]			

Table 15: Technical Summary Table

7.4 Options Cost Summary Table

The only viable option, as noted in Section 7.3 above is Option 1 (for the capex cost profile refer to Table 12, above).

Deriving valve remediation unit costs

To estimate the size and scale of valve remediation for our RIIO-2 and 3 programmes of work, we have used the cost intelligence gained within the RIIO-1 remediation programme. The complete set of results from the survey data was analysed and based on the deficiencies identified during the visual survey. An estimation was made of the potential scale of works required to make each valve compliant with PSR '96 in terms of being in good repair and working order.

We then distributed all the valves which will not have been remediated by the end of RIIO-1 into a 'low', 'medium' or 'high' complexity/unit cost range, for both MP and IP. These unit costs and the percentage of remaining valve population that falls within each of the cost ranges are summarised in the two tables below for IP and MP respectively:

<table>
<tr><th colspan="4">MP Valves Intervention Unit Cost Range</th></tr>
<tr><th>Network</th><th>Low Complexity</th><th>Medium Complexity</th><th>High Complexity</th></tr>
<tr><td>EA</td><td colspan="3" rowspan="5">Redacted due to commercial sensitivity</td></tr>
<tr><td>EM</td></tr>
<tr><td>Lon</td></tr>
<tr><td>NW</td></tr>
<tr><td>WM</td></tr>
</table>

Table 16: MP Valves Intervention Unit Cost Range (X)

<table>
<tr><th colspan="4">IP Valves Intervention Unit Cost Range</th></tr>
<tr><th>Network</th><th>Low Complexity</th><th>Medium Complexity</th><th>High Complexity</th></tr>
<tr><td>EA</td><td colspan="3" rowspan="5">Redacted due to commercial sensitivity</td></tr>
<tr><td>EM</td></tr>
<tr><td>Lon</td></tr>
<tr><td>NW</td></tr>
<tr><td>WM</td></tr>
</table>

Table 17: IP Valves Intervention Unit Cost Range (X)

The population of the remaining IP and MP SPIVs was distributed into the unit costs based on the percentages shown above to give us the cost profile in the previous section (Section 7.2).

8. Business Case Outline and Discussion

We considered three options for this investment case:

- Baseline: Fix the valve upon pipeline failure or when it is required for planned work.
- Option 1: Remediate all deficient valves during RIIO-2 and 3 (10 year program)
- Option 2: Remediate all remaining valves during RIIO-2 (5 year program)

8.1. Key Business Case Drivers Description

As stated in Section 6, we have not used CBA for this investment programme. The key business-case driver is customer and employee safety and legal compliance with Pipelines Safety Regulations, 1996.

8.3. Business Case Summary

	Baseline: Reactive fix on fail	Option 2: proactive remediation over 5 years	Option 1: proactive remediation over 10 years
Proposed capex investment in RIIO-2	Unknown Cost model for this option has not been built as failure data of instances where valves have not functioned in an emergency is not available	Redacted due to commercial sensitivity	
Volume of valves to be remediated	N/A	4,183	1,877
Pro's	Appears to be a low-cost option – however, it leaves significant risks which, if they emerge, would be very expensive.	Faster improvement in valve condition	Balanced risk; focussing on most critical valves in RIIO-2. While a 26% increase in workload from RIIO-1, volumes anticipated to be deliverable. A reasonably practicable approach
Con's	Non-compliant with Pipelines Safety Regulations Very high risk to safety, security of supply and has legal implications.	Significant increase in costs Not deliverable; significant step-up in workload not sustainable for the supply chain.	Some residual risk (mitigated through ongoing survey), but overall a manageable plan.

Table 18: Business case summary for all options considered.

Our RIIO-2 forecasts, as well as adjusting for workload and work mix factors, also include ongoing efficiencies flowing from our transformation activities including from updating and renewing our contracting strategies. Our initiatives are outlined in Appendix 09.20 Resolving our benchmark performance gap. For Capex activities this seeks a 2.9% efficiency improvement by 2025/26 on the end of RIIO-1 cost efficiency level. We have not applied specific efficiency to this element of investment.

For Valves (IP / MP valves) our confidence is at Conceptual Design stage with a range of +/-20%. This assessment reflects the uncertainty of the work that will be identified post excavation.

9. Preferred Option Scope and Project Plan

9.1. Preferred option

The preferred option is Option 1, to remediate all non-compliant valves over a 10-year period (throughout RIIO-2 and 3)

9.2. Asset Health Project Spend Profile

The table below shows the overall SPIV spend profile over RIIO-2 (in X):

Distribution Network	2021/22	2022/23	2023/24	2024/25	2025/26	Total
EoE	[redacted]					
Lon						
NW						
WM						
Total						

Redacted due to commercial sensitivity

Table 19: Preferred spend profile for Strategic pipeline isolation valves

9.3. Investment Risk Discussions

This programme of work has the following delivery risks:

Reference	Risk Description	Impact	Likelihood	Mitigation /Control
09.31 - 001	Supply & Demand deliverability risk of Resource availability within the Gas industry	Potential cost increases in labour / commodity markets as demand is greater than supply	Low	Intelligent procurement and market testing. Apprenticeship and Training programmes to fill skills gaps
09.31 - 002	Stretching efficiency targets may not be deliverable (unit costs increase)	Outturn costs are not met increasing overall programme costs.	Low	Established market place - ability to manage the known commodity market
09.31 - 003	Unforeseen outages and failures restrict access for planned work	Programme and delivery slippage due to delay of planned outages and or site access	Low	Proactive asset management with ongoing condition surveys and response plans to prevent failures
09.31 - 004	Unseasonal weather in 'shoulder months', Autumn and Spring reduce site access/outage windows	Increased demands affecting access to sites and planned outages delay and cost increases	Low	Controlled forecasting and maintenance of flexibility to react to unforeseen events. Detailed design solutions to minimise outages and reduce exposure.
09.31 - 005	Unexpected / uncommunicated obsolescence during RIIO-2 period of equipment components	Inability to maintain equipment at full capacity with risk of impact upon supply	Low	Maintain a close relationship with equipment supply chain and manage a proactive early warning system where spares / replacements become at risk.
09.31 - 006	Legislative change - There is a risk that legislative change will impact the delivery of our work.	Potential increase in the amount of consultation and information exchange required and require us to align our plans with the safety management processes operated by 3rd Party landowner / asset owners. The potential impact is more engagement and slower delivery	Med	We have established management teams to address these issues. We have also identified UMs for key areas.

Reference	Risk Description	Impact	Likelihood	Mitigation /Control
09.31 - 007	Inability to deliver increased volumes of sites	Supply chain impacts and Contractor confidence	Low	Operations, Contractor and Supply chain engagement. Robust procurement strategy

Table 20: Risk Register

9.4 Regulatory Treatment

This investment will not be processed through the NARMs reporting tool.

Cost variance for low materiality projects such as this will be managed through the Totex Incentive Mechanism (TIM).

This investment for HP Valves is accounted for in the Business Plan Data Table 5.18 Bespoke & Uncertain Activities within the Uncertain Activities Sub Table. The investment for MP/IP Valves is accounted for in the Business Plan Data Table 3.05 Other Capex within the Other Capex: Projects XXXX Aggregated Sub Table under the MP/IP Valves line.