Engineering Justification Paper: EJP17

Pressure Reduction on Offtakes and PRS

Cadent
Your Gas Network

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1 Summary Table

Name of Programme	Pressure Reduction on Offtakes and PRS'
Programme Reference	EJP17
Primary Investment Driver	Asset Health – Reliability
Programme Initiation Year	2027
Programme Close Out Year	2031
Total Installed Cost Estimate (£)	[cost data redacted]
Cost Estimate Accuracy (%)	+- 10%
Project Spend to date (£)	RIIO-2 spend to date is [cost data redacted] RIIO-3 spend to date is [cost data redacted]
Current Project Stage Gate	Rolling programme of investment
Reporting Table Ref	5.01 LTS storage and entry
Outputs included in RIIO-3 Business Plan	Yes
Spend apportionment (RIIO-3)	[cost data redacted]
Proposed Regulatory treatment for RIIO-3 workplan	Managed via NARMs (network asset risk metric)

Table 1: Summary Table

Note: Unless otherwise stated, all prices are pre-efficiency and are in a 23/24 price base throughout this document

This investment case does not satisfy the criteria for late competition or early competition and pursuing these activities would not be in the interests of the customer. We recognise the benefits that competition can bring to customers through efficiency and innovation. We continue to challenge ourselves as a business to ensure that we are harnessing competitive forces where they can provide these benefits. For specific detail on how we have assessed competition, please see Chapter 6 of the Workforce and Supply Chain Strategy (Appendix 17).

2 Executive Summary

Our Offtakes and PRS's (Pressure Reduction Systems) manage the reduction in pressure between the National Transmission System, our Distribution system and to customers' homes. These asset comprise typically pressure regulators or flow control valves (FCV's) which manage the pressure and flow of gas to meet demand, and "slamshut" safety devices which prevent over-pressurisation of our downstream system. We need to maintain these assets to ensure that we provide a reliable and safe service to our customers that fully complies with our Pressure Systems Safety Regulations (PSSR, 2000) obligations.

The primary driver for investing in our Offtakes and PRS's is asset health. We target our investment on aged systems which are in the worst condition or with the highest fault rates, whilst considering the relative criticality of each site in ensuring network resilience. Another key driver contributing to this investment case is reducing our carbon emissions, which is in line with our and the UK's wider ambitions. Given this investment is driven by system reliability (asset health), we will seek opportunities to be greener and more efficient through installing newer technologies which are non-venting.

We have modelled the asset health risk of our pressure reduction assets, considering the site-specific consequences of failure on security of supply, and the likelihood of failure based upon a number of factors including fault history and condition data from inspections. This approach is described in section 5 of our Network Asset Management Strategy. Our model demonstrates an ongoing need to invest in pressure reduction assets to maintain a stable asset risk position, ensure compliance with PSSR, 2000, and continue to deliver a reliable service to our customers.

Our proposed approach for RIIO-3 is consistent with RIIO-2, in that we will invest in highest risk systems based upon condition. In RIIO-3 we will manage interventions at a system level rather that component level, which will drive consistent delivery and reporting, which will also aid future investment decision making. We have used our asset model to derive a range of programme options based on different goals.

In RIIO-2 our outturn forecast is [sensitive information redacted]. In RIIO-3 our preferred option will invest in [sensitive information redacted]. This system replacement comes with increased labour costs, design costs and complexities to projects however comparable to RIIO-2 where difficulties have been observed in finding like for like replacements for components and therefore having to do system replacement instead.

The below table shows our predicted RIIO-2 spend, and our proposed investment spend for RIIO-3 and RIIO-4

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Table 2: Spend across regulatory periods

3 Introduction

This document covers the investment justification for Flow Control Valves (FCV's), regulators and slamshut systems at our Offtakes and Pressure Reduction systems (PRS) sites. Pressure reduction systems facilitate the pressure reduction from national transmission network to our distribution network. This pressure reduction is required to safely transport gas to our customers. These systems normally comprise regulators or flow control valves and slamshut devices. Regulators and Flow Control Valves control the pressure or flow of gas through Offtakes and PRS installations. Slamshuts are safety devices which protect the downstream network from over-pressurisation should a failure occur on the main pressure regulators.

Our investment need is based on the probability and consequence of failure at system level. Offtakes and PRS systems are functionally similar and have common failure modes, but the consequence of a failure on an Offtake could be much more significant in terms of supply interruptions compared to a PRS because of the number of customers they supply. We have assessed the site-specific monetised risk posed by each of our Offtake and PRS sites through modelling, considering asset deterioration, failure modes, probability and consequence of failure. This has been used to create workload volumes and forecasted expenditure for the RIIO-3 period. Our approach to modelling is discussed in more section 5 of our Network Asset Management Strategy (NAMS).

We have used the asset risk modelling to develop standardised investment options. Using these we have demonstrated an optimised programme to manage asset risk and maximise investment benefit.

4 Equipment Summary

This section sets out the different FCV's, regulators and slamshuts in use, provides a summary of the number of each type by region and then gives a summary of the current condition of the asset stock.

4.1 Overview of the assets

	Summary information
Location on the network	These are located on the network at points where [sensitive information redacted]
Normal operating modes	These systems typically operate in a working stream / standby stream configuration. • For pressure regulating systems, one stream will have a higher set point than the other and this will be the working stream. The other (standby) stream will have a lower set point and only operate should the outlet pressure drop. This may be different with systems with more than two streams and may work in a 50%/50% /standby configuration. This will be to ensure a sufficient volume of gas is entering the downstream network. • For FCV's, these also work in a working stream / standby stream configuration like pressure regulating systems, however these will not have a pressure set point, as these systems focus on ensuring a sufficient volume of gas is entering the downstream network and can be controlled centrally be our ECC (energy control centre) to meet changes in demand forecasts.
Redundancy architecture	We design the network to a N+1, where N = the total number of streams required to maintain designed capacity. This is an industry standard as per IGEM TD/13 edition 3. All Offtake and PRS systems shall have a standby stream which is able to take 100% of design capacity, which meets our 1:20 peak demand as per our licence obligations.
Global equipment count.	We have 620 sites operating above 7 bar, that contains some form of pressure-reduction, across the four gas distribution networks. Of the 620 sites, there are 48 Offtakes and 572 PRS'.

	Summary information
Breakdown of manufacturers / models	We have 5 manufacturers of FCV's and 30 manufacturers of regulators and slamshuts, with over 50 models.

Table 3: Asset overview: flow control systems

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Figure 1: Pressure reduction and flow control systems of the Offtakes and AGIs

Figure 1 illustrates a site with a separate filtration system. In some sites, the filters are included within the PRS. The filters would be positioned between the first valve and the final protective device (FPD) slamshut component. The orange section of the image shows the typical arrangement of a pressure reduction system.

Glossary of Terms:

PRS – Pressure reduction system – typically, within a pressure-reduction Installation. There are two streams which contain an inlet valve which may be part of the final protective device (FPD), two pressure regulators and an outlet valve.

FPD – Final protective device – sometimes termed slamshut valve. The FPD is designed to operate and close should the pressure exceed set limits downstream.

FCV – Flow control valve – controls the rate of flow rather than the pressure. FCVs will operate to a profile set and controlled by ECC to ensure sufficient gas enters the network to meet demand. FCVs require a controller to position the valve to achieve the desired flow rate.

REG – Regulator – controls the pressure rather than the rate of flow. Regulators will operate to a profile set to ensure sufficient gas enters the network to meet demand.

As mentioned in the summary table above we have 5 manufacturers of FCV's and 30 manufacturers of regulators and slamshuts. This investment case addresses issues across our global population of relevant assets; however, we are observing issues specifically with Jetstream and V25 regulators and therefore have a particular focus on these makes and models.

Across these various pressure-reduction systems, there are several key components. Below provides an overview of these components, with particular focus on V25's and Jetstream's.

4.1.1 Regulators

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Figure 2: Jetstream type regulator

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Figure 3: Fisher V25 Regulator

4.1.2 Slamshut

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Figure 4: Slamshut

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Figure 5: Actuator associated with Slamshut

4.1.3 Flow Controllers

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Figure 6: Bristol Controllers

4.2 Global equipment count

Table 4 contains a summary of the population of above 7 bar sites and systems including the breakdown of FCV's, regulators and slamshuts across our networks.

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Table 4: Detailed equipment summary by region. (Asset Model – extracted November 2024)

Table 5 provides a breakdown of asset age for FCVs, regulators and slamshut devices. This shows that [sensitive information redacted], of which [sensitive information redacted] of these are FCV's. Our data shows increased fault rates from at [sensitive information redacted], as described in section 6. This coupled with a decline in availability of spares results in increasing difficulty in maintaining our assets and increases the likelihood of failure and supply interruption. All V25 and Jetstream regulators fall into this category and [sensitive information redacted].

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Table 5: percentage distribution of asset age for all networks. (Asset model – extracted November 2024)

Our pressure reduction assets are subject to a rolling maintenance and inspection regime. During these inspection we obtain observed condition data. This, coupled with fault reports, provides a robust view of the health of an asset. We use this data to inform our asset risk models and determine the need for investment. The following table shows todays average health score of these assets split by network and a cadent average.

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Table 6: Average Asset type health score, by network and as Cadent average (Asset model – extracted November 2024)

Our position by the end of RIIO-2, start of RIIO-3 [sensitive information redacted]

Health scores range from 1-5, 1 being excellent health and 5 being very poor health. See NAMS for methodology on how these health scores are derived

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Table 7: Spend to date per network

5 Problem Statement

Regulators, slamshuts and FCVs are critical component on our Offtake and PRS sites, as they ensure that safe control of gas pressure and flow to supply our distribution network and end customers. The investment driver for these assets is to mitigate the risk of supply interruptions and environmental emissions impact, caused by asset deterioration and failure. We have a statutory obligation per licence condition 16 to ensure security of supply to meet our peak 1:20 demand. Furthermore, we have a duty to comply with PSSR regulations 8 (inspections) and 12 (repair of pressure systems). In section 4.1, we outlined challenges with Jetstream's and V25 regulator failure rates, declining spares availability, and instances of restricted capacity due to vibration. These systems use flow control valves and are predominantly located on Offtakes, and which have potentially significant impact on downstream supply.

At the start of RIIO-3, our modelling informs us that [sensitive information redacted]. Our strategy is to hold asset health stable and ensure security of supply to our customers by remediating systems that pose the greatest service risk. This is assessed relative to the engineering need (condition, faults, downtime challenges) and criticality to service (number of customers impacted and network configuration). Our investment seeks to mitigate the risks posed by high risk, poorer performing assets, and those with known challenge on availability of spares

Failure to invest in these systems would put us at risk at not meeting our statutory obligations of providing a safe and reliable gas supply to our customers or meeting our 1:20 peak demand. Due to newer more efficient technologies, this investment will also help reduce our carbon emissions, by having non-venting assets in operation.

5.1 What happens if we do nothing

As our assets age and deteriorate they are more prone to failures, which in turn affects the ability of these assets to meet safety and reliability requirements.

The following summarises the risks if we do nothing:

- Safety: We must comply with PSSR, 2000 Regulation 8 (written scheme of examination for inspections) together with intervention, as required, in relation Regulation 12 (Repair). We have an obligation to prevent serious injury from the hazard of stored energy because of the failure of a pressure system or one of its component parts. We have a robust maintenance regime for our FCV's, regulators and slamshuts, however due to the unreliability of some systems with limited access to spares, we are seeing an increased frequency of bespoke works being carried out to ensure operation and compliance. Without this maintenance regime on our FCV's and regs/slams, this poses a safety risk, due to the fire and explosion risk from a leak, following a failure. The consequences modelled in our AIM model are fatalities and minor injuries following ignition.

- Environmental: Loss of containment will result in a gas-release to the atmosphere, with a resulting impact to carbon emissions. We have a target to reduce our emissions, therefore an option that undermines our environmental commitments is not favourable.

- Regulatory compliance: We have a legal obligation to inspect and maintain these assets under the PSSR, 2000. Those systems that fail to comply within the allowable tolerances, would need intervention to remain compliant and ultimately ensure resilience in the network.

- Security of Supply: We have a duty to comply with the terms of our gas transporter licence, specifically Condition 16 (Pipeline System Security Standards) to manage our network to meet the demand of connected customers by supplying to meet the peak aggregate daily demand. Any option that restricts our ability to meet of this condition is not favourable. PRS system failures could cause asset or site outage, resulting in customer supply interruptions. Depending on the configuration of the network and the size of the site, this could result in a significant number of customers being impacted.

- Financial: Any PRS system failure will have resulting costs to respond and mitigate the failure, to re-establish operation, repair and restore service. Repair costs also increase with the life for all our flow control and pressure reduction systems. Options that negatively impact the customer bill or result in penalties through fines is not favourable.

- Customer Interruptions: Safety and resilience are non-negotiable. Customers place a high premium on the safety and resilience of the network. Therefore, any investment must focus on minimising and mitigating risks to prevent customer interruptions, ensuring a continuous, safe and dependable gas supply.

5.2 Key outcomes and understanding success

[Commercially sensitive information – section redacted]

5.3 Narrative real-life example

[Commercially sensitive information – section redacted]

5.4 Project Boundaries

[Commercially sensitive information – section redacted]

6 Probability of Failure

[Commercially sensitive information – section redacted]

6.1 Failure modes

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Table 8: Failure modes and consequences

6.2 Failure rates for each failure mode

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Figure 7: Failure rates over time for reactive only, which is our baseline do nothing option (Asset model - extracted November 2024

6.3 Probability of Failure Data Assurance

7 Consequence of Failure

[Commercially sensitive information – section redacted]

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Table 9: Consequence of failure

8 Options Considered

[Commercially sensitive information – section redacted]

8.1 How we have structured this section

[Commercially sensitive information – section redacted]

8.2 Modes of intervention

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Table 10: Intervention modes used in Programme options

8.2.1 Mode 1: Repair of FCV's, regulators and slamshuts

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Table 11: Intervention mode 1: Reactive repair

8.2.2 Mode 2: Minor refurbishment

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Table 12: Intervention mode 2: Minor refurbishment

8.2.3 Mode 3: Major refurbishment

Commercially Sensitive Information Redacted

Table 13: Intervention mode 3: Major Refurbishment

8.2.4 Mode 4: Full system replacement

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Table 14: Intervention mode 4: Full system replacement

8.3 Timing choices

[Commercially sensitive information – section redacted]

8.4 Options

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Table 15: Intervention modes against timing choices

8.5 Programme Options

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Table 16: Programme options

8.6 Technical Summary Table: Programme Options

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Table 17: Summary of Programme options

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Figure 8: Condition profile for each programme option by end of RIIO-3 (Asset model – extracted November 2024)

9 Business Case Outline and Discussion

[Commercially sensitive information – section redacted]

9.1 Key Business Case Drivers

[Commercially sensitive information – section redacted]

9.2 Business case summary

[Commercially sensitive information – section redacted]

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Table 18: Programme options comparison

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9.3 Discussion of results

9.3.1 Risk removal

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Figure 9: monetised benefit to avoid customer interruptions (relative to baseline option) per option (Asset model – extracted November 2024)

9.3.2 Cost Benefit Analysis

Commercially Sensitive Information Redacted

Table 19: Programme options 3 CBA factors

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Table 20: Programme options 2,4,5,6,8 and 9 CBA factors

9.3.3 Customer views

[Commercially sensitive information – section redacted]

9.3.4 Deliverability

[Commercially sensitive information – section redacted]

9.4 Conclusions

[Commercially sensitive information – section redacted]

9.5 Sensitivity analysis

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Table 21: Sensitivity testing

10 Preferred option scope and project plan

[Commercially sensitive information – section redacted]

10.1 Preferred Option

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Table 22: Intervention volumes; preferred programme option

10.2 Asset Health Spend Profile

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Table 23: Spend profile: Preferred programme option

10.3 Investment Risk Discussion

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Table 24: Risks

10.4 Project Plan

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Table 25: Proposed programme of PRS system replacements

10.5 Key Business Risks and Opportunities

[Commercially sensitive information – section redacted]

10.6 Outputs included in RIIO-2 plans

[Commercially sensitive information – section redacted]

11 Regulatory Treatment

[Commercially sensitive information – section redacted]

12 Glossary

Term	Definition
CBA	Cost Benefit Analysis
EJP	Engineering Justification Paper
FES	Future Energy Scenarios
NARM	Network Asset Risk Metric
NPV	Net Present Value
PSSR	Pressure Systems Safety Regulations

Table 26: Glossary Table