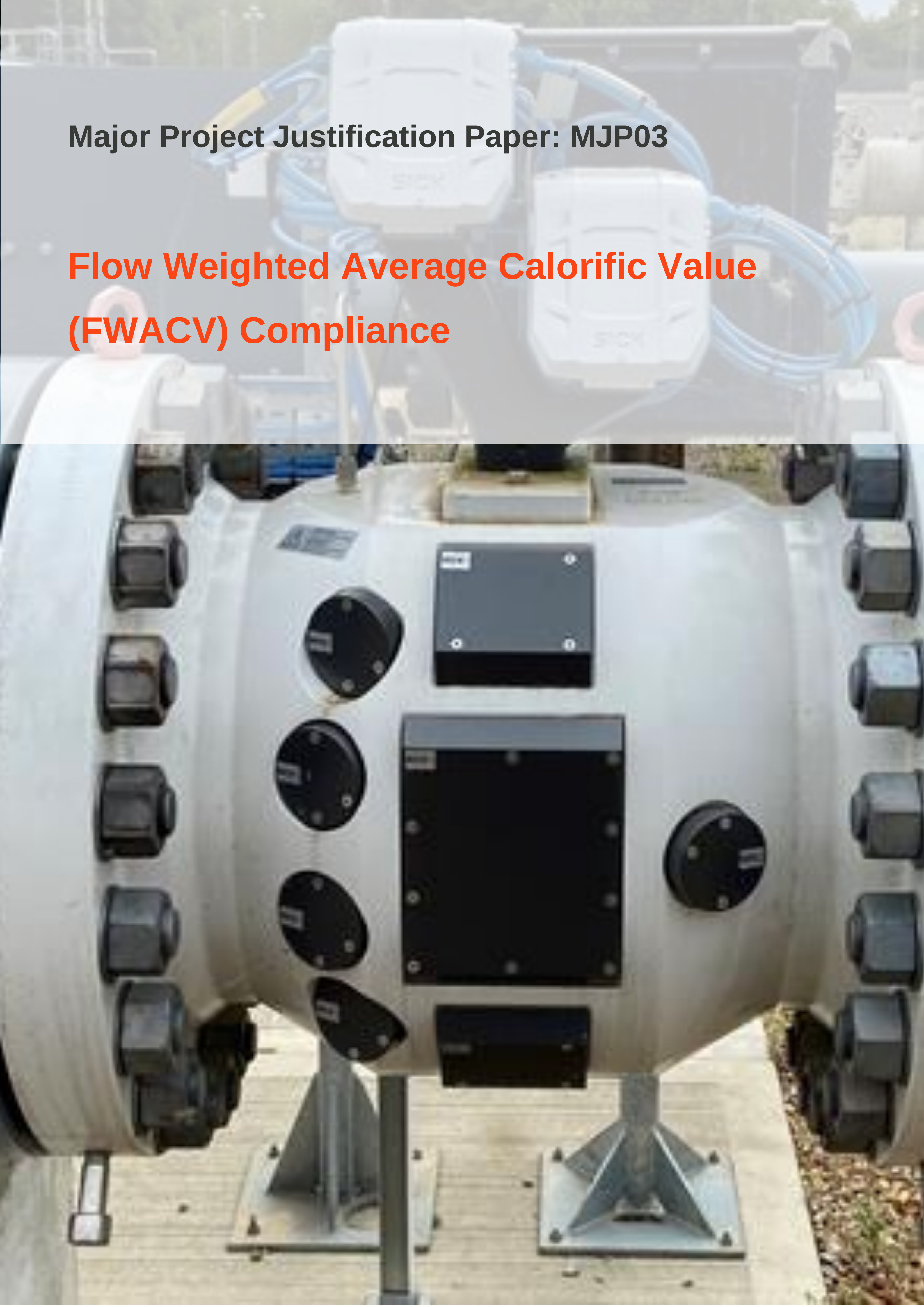
Major Project Justification Paper: MJP03

Flow Weighted Average Calorific Value (FWACV) Compliance



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1 Summary Table

Name of Project	FWACV Flow Weighted Average Calorific Value Compliance		
Scheme Reference	MJP03		
Primary Investment Driver	Asset Health: Resilience, Reliability, and Compliance		
Project Initiation Year	MJP inception date: 2021		
Project Close Out Year	Ultimate project completion date: 2031		
Total Installed cost estimate (£)	[cost data]		
Cost Estimate accuracy (%)	+/-5		
Project Spend to date (£)	[cost data]		
Current Project Stage Gate	Current stage gate for the RIIO-3 work-plan: Detail design, & Purchase of long lead items for Batch 1 RIIO-3 (10 systems)		
Reporting Table Ref	5.01 LTS, Storage & Entry_PRS_Other Systems, NTS Offtakes: Meter Supply Upgrade		
Outputs included in RIIO-2 Business Plan	Yes		
Spend apportionment (for RIIO-3 plan)	RIIO-2	RIIO-3	RIIO-4
	[cost data]	[cost data]	[cost data]
Proposed Regulatory treatment for RIIO-3 workplan	PCD		

Table 1: Summary Table for FWACV Compliance

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).

The investment spends and volumes discussed in this paper have been derived from our investment methodology (this is discussed in more detail in our Network Asset Strategy) through the assignment of health scores per asset, asset criticality and service risk metrics. By developing standardised investment options, we can demonstrate an optimised programme to manage asset risk and maximise investment benefit. This has been developed using our AIM (Asset Investment Manager) model, utilising actual fault rates to calculate the consequence of failure for each to derive a monetised risk value.

All costs presented in this paper are pre-efficiency and are in 23/24 price base, unless otherwise stated.

2 Executive Summary

This programme continues the crucial work of upgrading aging Flow Weighted Average Calorific Value (FWACV) systems initiated in RIIO-2, aiming to modernise all remaining systems to the same standard. We are currently on track to complete the [sensitive data].

Prior to undertaking the FWACV Compliance project in RIIO-2, the pre-emptive upgrade of the entire FWACV system was discussed with the Uniform Network Codes (UNC) Performance Assurance Committee (PAC) on the 12 Nov 2019. The PAC was supportive of the approach proposed by us to ensure maintenance and improved accuracy.

A large proportion of our FWACV measurement systems have no redundancy via either a standby meter stream or readily available spares, due to the orifice plate configuration they typically operate at a flow rate uncertainty [sensitive data]. level outlined in the UNC's Offtake Arrangement Document (OAD)[1].

Modernising these systems with Ultrasonic Meters (USMs) not only ensures greater accuracy, meeting the OAD standard, but also improves reliability and reduces the likelihood of service disruptions. Critically, this investment provides future adaptability, supporting the integration of renewable gases like biogas and hydrogen into the evolving energy landscape.

We have considered three main intervention modes comprising reactive repair, reactive replacement, and pre-emptive replacement. We have then developed seven programme options including our baseline case, which are detailed in section 6.5.

Below is a table to compare awarded spend and volume with the current forecast volume & spend:

[redacted]

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The observed cost increase from the RIIO-2-FD allowance compared to the forecast is primarily attributed to evolving project requirements. This variance stems from the dynamic nature of large-scale projects, where unforeseen complexities and market fluctuations necessitate adjustments to initial cost estimations. It is important to recognise that the original estimations were formulated with limited knowledge on projects of this magnitude.

As the company had not previously undertaken a project of this scale, the initial cost projections were necessarily based on less comprehensive information. The observed cost variance can therefore be viewed as a reflection of the valuable knowledge and experience gained throughout the RIIO-2 project lifecycle. This enhanced understanding has enabled us to inform and refine future project estimations and the strategic planning processes.

[1] Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix K for information regarding OAD % agreements.
2 RIIO-2 FD Awarded is [cost data] in 18/19 price base uplifted to 23/24 price base for comparison across regulatory periods.

3 Project Status and Request Summary

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Figure 1: FWACV System named sites by measurement risk RIIO-2-3 Delivery, [3]

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Table 3: Summary of Complaint FWACV systems by the end of RIIO-2 with proposed RIIO-3 systems

4 Problem/ Opportunity Statement

Our customers expect a safe, secure, and reliable network. Our FWACV measuring systems enable the balancing of supply and demand between the National Transmission System (NTS) and our gas distribution systems and are critical in determining consumers' bills, and in ensuring our continued compliance with regulations including safe dosing of odorant.

We are investing in our FWACV systems to improve the health of this asset group and address the current risk posed by our orifice plate measurement systems with the decline in readily available spares through our supply chain. Further, we have been issued a Performance Improvement Notice (PIN) due to an increased volume of measurement errors relating to our current fleet of legacy FWACV systems, they also do not offer resilience, or the reliability and accuracy to meet the 1% operational tolerance outlined by the UNC.

4.1 Why are we going to do this project

This project is crucial for fulfilling our Performance Incentive Plan by replacing [sensitive data] measurement systems with newer, more accurate models.

These new systems will lead to improved operational resilience, making our services more robust and less prone to failures. The increased accuracy and tighter measurement tolerances will also improve our adaptability to network changes, ensuring continued efficiency and performance, and compliance with the OAD. Furthermore, accurate measurement guarantees fair and transparent billing for our customers.

Finally, the new systems will minimise gas venting, which enhances safety for both our workforce and the public while reducing our environmental impact and contributing to a more sustainable operation.

3 Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix D for RIIO-2 programme of works

4.2 Investment alignment to OFGEM outcomes

Our investment is aligned to deliver against OFGEM's outcomes and our network asset strategy. These are discussed in detail in the network asset strategy paper.

- Secure and resilient supplies: The primary investment driver is to comply with our obligations under the Statute Gas (Calculation of Thermal Energy) Regulations (Section 12), license conditions and UNC
- Infrastructure fit for a low-cost transition to net zero: Being able to reduce our emissions is a benefit to this investment case from the reduction in the need to vent metering streams. We are always exploring new technologies that are greener than equipment currently in use today. This is in line with our and the UK's wider strategy to invest in infrastructure fit for net zero
- High quality service: Continuing to keep the energy flowing and ensuring customers have access to high quality and reliable service. By investing in these systems to improve our reliability, measurement accuracy, as well as reducing the likelihood of measurement errors, we continue to provide this service with an accurately costed gas supply to our customers
- System efficiency and long-term value for money: This goes hand in hand with reducing our environmental impact and improving our measurement accuracy. New technologies are cleaner, more reliable, and more accurate than our current fleet which directly affects customers' bills

4.3 Asset Age Profile

For context, the typical design life of FWACV technology is 15 years due to constant technological advancements. The metering streams such as pipework and housings, by nature are designed to outlast the technological side of the FWACV systems as they are predominantly static installations.

We do currently operate with assets that have exceeded this age and are still functional, however, assets operating beyond their operational design life increase the likelihood of asset failure, mismeasurement errors and the associated asset downtime to resolve. Failure of such assets has an impact on both operation of the network from a safety, security of supply perspective, financially through direct OPEX, and has a direct impact on shippers.

The following visuals illustrate a percentage view of asset age of FWACV assets.

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Figure 2: Year of install % by region: FWACV (Asset life circa 15 years.)

Based on the data presented in Figure 2, it is evident that [sensitive data] of our FWACV assets have exceeded their designed service life.

4.4 Asset Condition Profile [4]

The base data used in the asset health model is sourced from [Corporate system], utilising a combination of the asset health index score, historical fault data, available spares through our supply chain, and validation through

4 Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix A for information on the basis for Health Index Score condition grading.

internal stakeholder engagement and Subject Matter Expert (SME) engineering knowledge. It has enabled us to determine a current health score of our assets.

Below is a visual representation of the current condition grade of our Metering and FWACV assets:

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Figure 3: Condition Profile of FWACV Assets by Network

Using validation through internal stakeholder engagement and SME knowledge sessions has enabled us to determine the health score of assets from the 2016-2018 static score surveys. The age and condition profile reveals that a significant portion of FWACV assets have surpassed their expected service life as seen in Figure 2, with further assets projected to reach end-of-life within the RIIO-2 period. This combined with a fleet of poor condition HI4-5 scoring assets inclusive of FWACV [sensitive data], poses a potential risk to the network's reliability and resilience and therefore security of supply, potentially leading to increased faults, increased mismeasurement errors, reduced operational efficiency, and compromised safety.

The FWACV system has the following failure modes/faults:

Failure modes	Fault Type / Reason	Consequence
Loss of Metering	Orifice carrier failure	Unable to meter gas volume / energy.
	Obsolete flow computer failure	
	Obsolete turbine meter failure	
Inaccurate Metering	Drift of instrumentation / flow computer between validations	Measurement error (meter error reporting) Incorrect level of odour added to gas. Network balancing
	Lower flow rates than the measurement system is designed to operate at	
	Operational issues	
Loss of Calorific Value	Loss of Chromatograph due failure and unobtainable spares,	Potential for Measurement error (MER) Submit a 'Loss of Record' to Xoserve resulting in attribution process (potential Shrinkage)
	Carrier Gas Change over valve failure and unobtainable spares	

Table 4: Fault and Consequence of FWACV measurement systems

We have estimated the future failures likely over time for the 'Do nothing' scenario. The below graph identifies the increase in likelihood of all failure modes identified in Table 4.

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Figure 4: Predicted annual FWACV system faults over time

For each fault, we estimate the following consequences of failure:

- Meter Investigation Costs(£m)
- Leakage (£m)

We have then applied the service risk framework valuations to the above consequences to generate graphs of the total monetised risk of "doing nothing" (other than reactive repair and maintenance).

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Figure 5: Meter Investigation monetised risk for do nothing

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Figure 6: Environmental monetised risk comparison for do nothing

The graphs show that there is a direct relationship between the increase in failures to the associated monetised risk. Without pre-emptive investment, failures will continue to rise. When this is considered with the current performance of our FWACV fleet, the likelihood of further significant meter errors could occur if we do not continue to invest.

4.5 The investment drivers, problems, and opportunities

4.5.1 Problems

On the [sensitive data] the UNCs PAC, because of excess offtake errors on our networks compared to other Distribution Networks. We presented [sensitive data] which identified two principle causes of measurement error; intrusive maintenance associated with orifice plate exchanges as well as contamination from biomethane plants impacting ultrasonic meters.

As our assets age and degrade, they become increasingly prone to failure, which, in turn, compromises their ability to meet the required standards. We have identified the following problems with our legacy FWACV systems:

- Security & Resilience: Our legacy measurement systems have limited redundancy. [sensitive data]. Any failures result in higher on-going maintenance costs and longer system outages, putting customers at risk of supply interruptions. As previously mentioned, the metering accuracy from legacy systems is lower than modern day USMs

Based on our engineering review of the remaining [sensitive data] systems for Phase 2 intervention, we have identified the following problems.

- [sensitive data]
- [sensitive data]
- [sensitive data]
- [sensitive data]
- [sensitive data]
- The systems have between [sensitive data], therefore even a small risk of failure at these sites caused by failure of the FWACV systems will have a material impact on customers.
- We have had [sensitive data] which have resulted in external MER's (Meter Error Reports).
- Measurement error, Shipper costs volatility and the impacts on competition: Offtake meter measurement errors can result in incorrect quantities of gas being allocated to Local Distribution Zone supply points, with the industry processes that calculate charges to shippers based on this allocation. A reconciliation exercise is undertaken following the identification of an Offtake meter measurement error, which can result in additional charges being applied to some shippers based on the correct quantities of gas that should have been allocated to their supply points. This scenario can present a cashflow risk to shippers, particularly to smaller parties that have less financial resilience to be able to meet an unforeseen additional charge. [sensitive data]
- Safety: New USMs will reduce the likelihood of measurement error. The advancement in technology such as bi-directional measurement, non-intrusive maintenance, real time diagnostics and advanced signal processing reduces the risk of incorrect odour injection. Accurate flow measurement is critical to ensure that the correct amount of odorant is used to ensure downstream customers can detect / smell a gas
- Environmental impact: The remaining meter asset stock requires gas-venting during routine and periodic maintenance and calibration. This increases greenhouse gas emissions and poses a risk to employees due to a fire / explosion risk
- License Obligation: We have an obligation to comply with our Offtake Arrangements Document, which is part of the wider UNC document, compliance with which forms part of our contractual obligations as a gas transporter. These documents place an obligation on us to achieve 1% accuracy[5]
- As a result of Significant Measurement Errors primarily due to legacy metering systems, we have had a request from Shippers to expedite the replacement of all our legacy metering systems to reduce the impact of error on the gas billing system. Significant Measurement Errors can have a detrimental financial effect to our shippers
- Failure of our FWACV systems will result in our failure to meet the Statute Gas (Calculation of Thermal Energy) Regulations, license conditions and UNC.
- These binding documents require us to provide an FWACV system that is fit for purpose, providing a reliable, accurate, safe, and efficient way to measure gas volumes and energy at our offtakes. GSMR Gas Safety (Management) Regulations (1996) (Regulation 8 Schedule 3 Part 1) states that "gas shall have been treated with a suitable odorant to ensure that it has a distinctive and characteristic odour"

5 [sensitive data]

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4.5.2 Opportunities

- Improve the efficiency of industry processes. Gas distribution networks, shippers, the Joint Office of Gas Transporters, and Xoserve have created processes to manage the identification, resolution, and data/charging reconciliation of Offtake meter measurement errors. Industry's resource volumes and system functionality is equipped to manage the current frequency of measurement errors. However, our expectation is that the likelihood of measurement errors could rise should our orifice plate meters are not upgraded, potentially increasing the costs to industry to manage a larger volume of errors. Delivering USM upgrades would deliver many benefits, including potential savings to industry by scaling back the resource and systems required to manage measurement errors.
- Enable "green gas" – biomethane connections: Our legacy metering systems have a limited operating range. As we transition towards a low-carbon gas supply using hydrogen or biomethane, it is likely that the gas demand and operating flows will need to vary. The use of modern-day equivalent USMs will support this by providing a wider operating envelope, enabling connections of further biomethane plants and allow for more green gas to be used in the network.
- Digitalisation: The upgrade of our FWACV systems, provides opportunities to automate and sensorise our assets; providing systems which enable additional monitoring and analytics to further reduce the risk of FWACV-system failures, and that are resilient to cyber and physical threats. Incorporating new technologies will aid ECC (Energy Control Centre) via the central SCADA system to inform network operational decisions. This will support the delivery of an efficient cost of service, minimising cost to consumers through the conveyance of natural gas today and in preparation for any system transformation.
- Reduced venting: The reduced need for gas-venting during routine and periodic maintenance and calibration will, reduce the risk associated with venting and aid in our efforts to reduce our carbon footprint.

4.6 What will change the investment need or project?

This investment is predominantly asset-health (not driven by capacity or growth). Modern USMs can accommodate a broad operating range which is an enabler for future transition opportunities within the network, we consider that metering will be required in all future scenarios for decommissioning or operating a blended network, therefore this investment case is not materially impacted by the FES demand scenario nor the timing of investment, further information can be found in section 5.1

4.7 Project challenges

As part of our RIIO-2 investment in our FWACV systems we have identified the following challenges which directly relate to this project:

- Sufficient space to enable buildability: There is a risk that some sites may have insufficient space to enable safe construction / site-cabins / lay-down areas, requiring additional land outside the current site boundary, with temporary consents or land-purchase
- Insufficient space to build the permanent works: The existing sites may be congested with limited land available to build the new FWACV systems. This may either necessitate a full site outage, or the need for land-purchase or other enabling activities to divert or move other equipment, increasing delivery costs
- Supply-chain capacity & deliverability risk of resource availability (labour, plant, and materials) within the Gas industry, driving up delivery costs
- Unforeseen outages and failures: Critical non planned work on the network can restrict access for the planned programme of work, this can lead to delays which could affect the overall timeline

- Unseasonal weather: Autumn and Spring weather is unpredictable and unexpected poor weather conditions which are becoming increasingly frequent may reduce site access/outage windows for planned programme works in the 'shoulder months'
- Available outage windows: Planning will be based around demand on the network determined by our ECC, in some instances there are systems which are unable to be taken offline due to the criticality and demand of the site. In these instances, there is an extra cost and challenges associated with live working

Our preferred option takes account of these challenges and seeks to deliver the programme in the most efficient and cost-effective manner.

4.8 Key milestone dates for programme delivery

Exact timescales cannot be determined until detailed design is completed of the system, generally we have found in RIIO-2 that key milestones for each programme are:

- Pre-emptive procurement of long lead items (12 months)
- Pre-emptive Detailed design (12 months)
- Pre-emptive Mobilisation & construction including commissioning (4-6 months)
- Record update and project close out (4-6 months)

4.9 Understanding programme success

Successful investment in RIIO-3 will be to improve asset health throughout the period with no compliance failures and a reduction in measurement errors.

This project focuses on standardising the remaining FWACV systems across the entire fleet. This standardisation will be achieved through [sensitive data] systems being completely replaced with new, modern systems featuring more efficient and accurate components.

This comprehensive approach to standardisation will not only enhance compliance but also improve the overall performance, reliability, and longevity of the FWACV systems and will enable us to realise the following:

- Ensure continued legislative compliance
- Delivering key commitments outlined to the UNC PAC [sensitive data] and improve shipper confidence
- Improve the overall Asset health of the remaining [sensitive data] systems and bring them up to the standard of the rest of the FWACV systems
- Providing modern-day equivalent flow meters that will increase the meter reading certainty to [sensitive data]
- Drastically reduce the need to vent when conducting routine maintenance activities and aiding our efforts to reduce carbon emissions
- Provide a safe, reliable, and cost-effective FWACV system at our offtake sites
- Enable effective flow balancing between gas distribution and transmission through the provision of accurate measurements of transported energy
- Providing appropriate resilience within our metering systems, to quickly and cost-effectively mitigate risks posed by single meter failures in the future
- Providing additional monitoring and analytics to further reduce the risk of FWACV-system failures
- Managing and remediating asset deterioration to ensure that we minimise safety risk and improve the security of supply to our customers

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4.10 Related Projects

4.11 Project Boundaries

The assets within the scope of this investment case cover the following aspects of the FWACV system:

- CVDD: [sensitive data]
- Metering system: [sensitive data]
- Flow computer and FWACV rack [sensitive data]
- Any immediately associated electrical, instrumentation, civil structure, housing, or pipework assets

The drawing below sets out the general layout of a typical dual stream metering system, noting standardising a standby metering stream for resilience in the event of measurement errors as well as ensuring compliance isolations within the metring streams, in accordance with IGEM/TD/13.

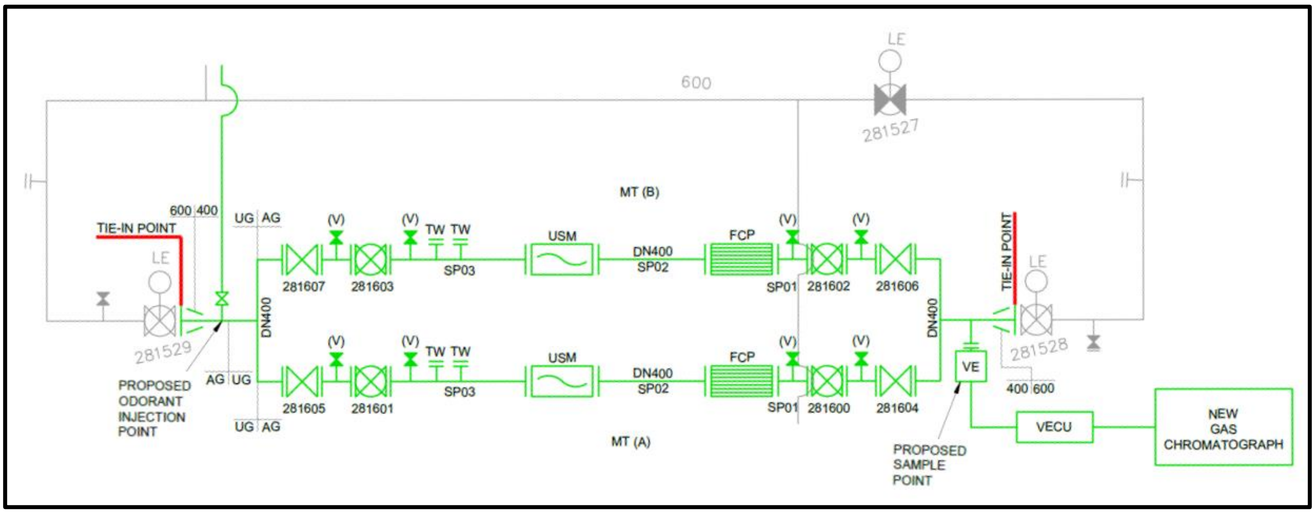

Figure 7: [sensitive data] FWACV system[6]

5 Project Definition

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5.1 Supply and Demand Scenario Discussion and Selection

5.2 Project Scope Summary

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6 Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix C for pre and post intervention design drawings.

6 Options Considered

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6.1 Modes on intervention[7]

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Table 6: Modes of Intervention

6.1.1 **Repair or replace FWACV components on failure**.

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Table 7: Intervention Mode 1: Repair or replace FWACV components on failure

6.1.2 Full FWACV system replacement

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Table 8: Intervention Mode 2: Full replacement of FWACV systems

[7] Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix M for further information on intervention modes

6.2 Options Cost Estimate Details[8]

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Table 9:Cost Summary Table: Pre-emptive system replacement (per site)

6.2.1 The Option Cost Estimate: Network Cost Variance

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Table 10: Unit cost per system with network variance applied

6.3 Timing Choices

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Table 11:Intervention mode timing choices

6.4 Programme Options

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Table 12: Programme Options

[8] Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix E for an overview on our costing methodology and our approach to FWACV

6.4.1 Basis of Programme Volumes

6.5 Technical Summary Table: Programme Options

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Table 13: Technical summary of options

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Figure 8: Condition profile for each scenario by end of RIIO-3

7 Business Case Outline and Discussion

[Commercially Sensitive Information: Section Redacted]

7.1 Key Business Case Drivers Description

7.1.1 Key business Drivers Summary [9]

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Table 14: Perceived value of each option as a business case

[9]Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix F for information on the basis for costs and benefits used in the CBA tables.
 Please see supporting evidence in file MJP03-SE-FWACV Compliance Appendix G for a detailed summary table of the CBA outputs for each programme option.

7.2 Supply and Demand Scenario Sensitivities

7.3 Business Case Summary

7.3.1 Discussion of Results

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Figure 9: Monetised benefit from reduction in emissions (relative to baseline option) per scenario

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Figure 10: Monetised benefit from the reduction in meter error investigation (relative to baseline option) per scenario

7.3.2 Sensitivity Testing

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Table 15:Sensitivity Test Table

7.3.3 Conclusion of Results

8 Preferred Option Scope and Project Plan

[Commercially Sensitive Information: Section Redacted]

8.1 Preferred Option for this Request

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Table 16: Volume of FWACV systems to be delivered in RIIO-3

8.2 Project Spend Profile

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Table 17: Forecast spend profile for proposed RIIO-3 programme

8.3 Efficient Cost

8.4 Project Plan

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Table 18: Project Plan

8.5 Key Business Risks and Opportunities

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Table 19: Key Business risks

8.6 Outputs included in RIIO-2 Plans

9 Regulatory Treatment

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10 Glossary

No.	Document Name
AIM	Asset Investment Manager
FWACV	Flow Weighted Average Calorific Value
UNC	Uniform Network Codes
PAC	Performance Assurance Committee
OAD	Offtake Arrangement Document
USMs	Ultrasonic Meters
CVDD	Calorific Value Determination Device
NTS	National Transmission System
PIN	Performance Improvement Notice
SME	Subject Matter Expert
MER	Meter Error Reports
ECC	Energy Control Centre
UCW	Unit Cost Workbook
PIP	Performance Improvement Plan