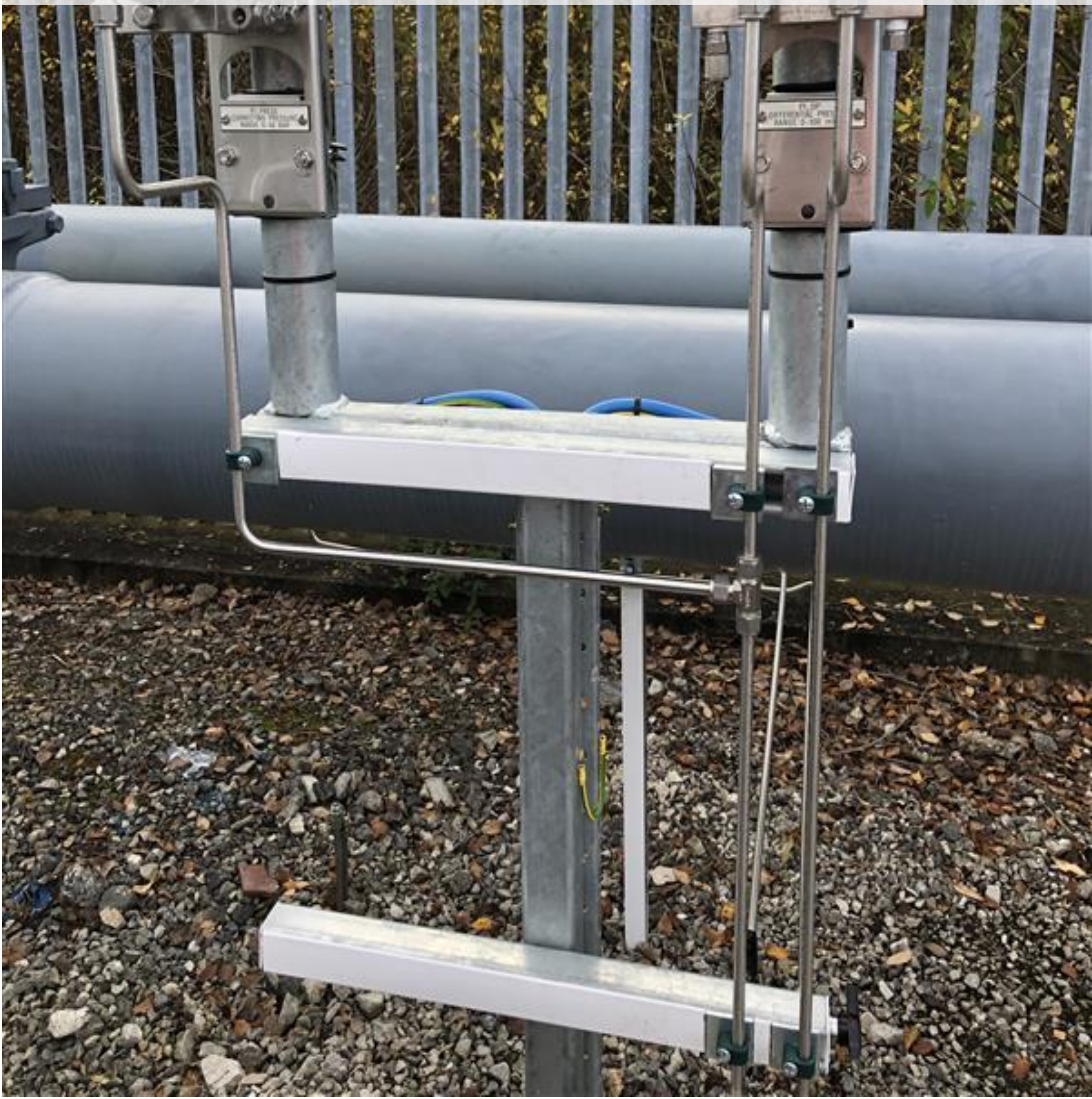
Engineering Justification Paper: EJP02

Electrical, Instrumentation and Telemetry on Offtakes & PRS



Cadent
Your Gas Network

Contents

CADENT - CONFIDENTIAL

Table of Figures

Table of Tables

1 Summary Table

Name of Project	Electrical Instrumentation and Telemetry		
Scheme Reference	EJP02		
Primary Investment Driver	Asset Health- Secure and Resilient supplies		
Project Initiation Year	**Start date for proposed RIIO-3 work plan**: 2026		
Project Close Out Year	**Completion date for proposed RIIO-3 work plan**: 2031		
Total Installed Cost Estimate (£m)	**Total installed cost for RIIO-3 work-plan** [cost data redacted]		
Cost Estimate Accuracy (%)	+/-5%		
Project Spend to date (£m)	**Spend to date for RIIO-3 work-plan**: [cost data redacted] **Spend to date for RIIO-2 work plan**: [cost data redacted]		
Current Project Stage Gate	**Current stage gate for the RIIO-3 work-plan**: Rolling programme of Asset Health investment		
Reporting Table Ref	5.01 LTS storage and entry, within the PRS and NTS Offtake Sub Tables under the Electrical and Instrumentation intervention lines.		
Outputs included in RIIO-3 Business Plan	Yes		
Spend apportionment (for RIIO-3 plan £m)	RIIO-2	RIIO-3	RIIO-4
	[cost data redacted]	[cost data redacted]	[cost data redacted]
Proposed Regulatory treatment for RIIO-3 workplan	Base		

Table 1: Summary Table

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).

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

2 Executive Summary

Electrical Instrumentation and Telemetry (EI&T) equipment is an integral part of our infrastructure and is used for a variety of purposes, including plant monitoring, alarm response, control, telemetry, metering, and Safety Instrumented Systems (SIS).

We are investing in EI&T systems to address the risk posed by a decline in readily available spares through our supply chain. Aged assets are typically at risk of being unsupported when they are superseded by newer technology, assets operating beyond their design life increase the likelihood of failure and the associated downtime to resolve. Failure of such assets has an impact on both operation of the network from a security of supply perspective, and, financially through direct OPEX.

Ensuring that we invest in our oldest and least reliable systems also allows us to leverage the ability to increase our resilience and reduce our carbon emissions where applicable. We have considered a pre-emptive and reactive approach to replacing this equipment. We have developed a rationale which is included in the "Options considered" section.

To effectively manage our EI&T assets, we have grouped our assets at a system level for investment. We have chosen this approach because focusing on individual asset investment fails to address the risks inherent in an aging EI&T system with limited or no spares. Replacing a single asset within a larger system does not effectively mitigate risk or improve overall reliability. Therefore, a system-level perspective is essential for developing a robust investment strategy.

As part of our analysis, we have combined the asset health model output with the Network Asset Risk Metric (NARM) deterioration methodology, this analysis has indicated that we need to continue to invest to ensure we are able to continue to manage and monitor the network effectively. If we do not invest, our assets become increasingly prone to failure, which, in turn, compromises their ability to meet essential safety and reliability standards.

Our proposed investment case for RIIO-3, will invest [cost data redacted] in our EI&T systems, holding asset health stable, while improving our operational resilience and reducing our carbon emissions, while delivering an investment strategy which balances customer expectations, cost and feasible workload.

Below is a table which summarises RIIO-2-GD3 cost and volume for EI&T systems:

Commercially Sensitive Information Redacted

Table 2: RIIO-2-GD3 Volume and Spend Profile

3 Introduction

This document covers the engineering justification for EI&T systems at Offtakes and Pressure Reduction System (PRS) sites. EI&T equipment is an integral part of our infrastructure for monitoring and managing our above 7 bar networks.

In RIIO-3 we continue to invest in our assets driven by asset reliability, accounting for performance and condition of our EI&T systems. Through our modelling and observed network condition, there is a specific focus in investment in our Offtakes. By nature, Offtakes are larger with more operational equipment on them and there is a relative increase in spend to intervene at these sites as compared to our PRS interventions.

We have created an asset health model which has been developed using the principles of the NARM methodology to generate an Investment Prioritisation List (IPL) for our EI&T systems.

Our analysis has enabled us to quantify the risk of our programme options. However, we have not used it for broader programme planning or optimisation because there is a complex correlation between failure and services which the industry does not currently model.

Our final investment cost and volumes have been derived by combining our asset model outputs with an asset and network specific unit cost; the methodology of which is discussed in our Network Asset Management Strategy (NAMS). This paper will provide information on the basis of unit costs in Section 0.

4 Equipment Summary

This section sets out the EI&T assets in use, provides a summary of the number of EI&T systems by site type and region, and then gives a summary of the current condition of the asset stock.

	Summary information
Location on the network	These systems are located on our above 7bar Offtakes and Pressure Reduction System (PRS) sites
Normal operating modes	EI&T systems are an integral part of operational gas sites and therefore operate continuously. This continuous operation is needed to ensure that the site is continuously monitored and controlled, as well as supplying raw power to buildings and security assets.
Electrical Redundancy architecture	Backup power to site via Uninterruptable Power Supply (UPS), permanent or standby power generation, batteries to maintain telemetry only for up to 8hrs (minimum/last line of defence)
Instrumentation Redundancy architecture	Instrumentation is configured in accordance with the mechanical operating modes of a working and standby stream. If there is an instrumentation failure an alarm is generated from the instrument. If the system fails mechanically, the instrumentation for monitor and control is replicated on the mechanical standby streams to ensure continued monitoring.

	Summary information
Telemetry Redundancy architecture	If the telemetry fails/comms go down, there is no redundancy. The ECC will utilise information from upstream and downstream sites (where available) to monitor the network until comms are back online, and/or the site will be manned until the fault is resolved.
Global equipment count	On our above 7bar Offtake and PRSs, there are 1335 installations which utilise EI&T systems

Table 3: Operational equipment summary information

4.1 Overview of the Assets

There are a wide range of assets which form part of the overall EI&T systems at Offtake and PRS sites. Depending on the site configuration, demand requirements and criticality, this will vary from site to site.

For context the typical design life for each asset is shown in the table below, we do currently operate with assets that have exceeded this age and are still functional, although when assets exceed their expected design life, they become more prone to non-repairable failures.

Asset	Typical Design Life (Years)
Electrical	25
Instrumentation	15
Telemetry	10

Table 4: Overview of EI&T design life

The EI&T assets on a "typical site" may include, but are not limited the following:

Electrical systems: Electrical systems are installed on operational gas sites to provide power to monitoring and protection equipment as well as raw power to building services, where required electrical supplies are backed up by standby generators and UPS systems to ensure there is a continuation of control and monitoring in the event of loss of power to the site.

[redacted]

Commercially Sensitive Information Redacted

Figure 1: Example. Electrical distribution system overview

- Low voltage distribution systems
- Earthing
- Cables
- Back-up power systems
- Security systems
- Valve actuators
- Heating and ventilation
- Lighting (i.e. task and emergency)

Instrumentation systems: Instrumentation systems are installed on the operational gas sites to monitor and aid control of the plant. Typical examples of instrumentation are:

Commercially Sensitive Information Redacted

Figure 2: Example, Instrumentation asset

- Pressure / temperature / level / flow transmitters & s
- Non-fiscal flow meters
- Cables
- Solenoids
- Valve positioners
- Galvanic / Zener safety barriers
- Electronic and pneumatic controllers

Telemetry equipment Telemetry Equipment includes:

Commercially Sensitive Information Redacted

Figure 3: Example: Telemetry cabinet

- Remote Terminal Units (RTU)
- Programmable Logic Controllers (PLC)
- Routers

- Cables
- Human Machine Interfaces (HMI)
- Ethernet switches
- Satellite indoor and outdoor units

These devices are used to collate and process the plant information and transmit it over a communications link to the ECC, typically every 60 seconds, via:

- Satellite
- Mobile Data (4G)
- Ultra-High Frequency (UHF) Radio

4.2 Detailed Equipment Summary

The number of above 7 bar systems within scope of this investment case have been identified from the SAP equipment register.

There is a collective total of 1307 Offtakes, and PRS sites which are operated and maintained by us containing EI&T systems. Of these, [sensitive data redacted] are monitored and/or controlled by ECC with the remaining [sensitive data redacted] sites only having raw power such as heating and lighting. The below table gives an overview of the total systems which contribute to these sites split by network and asset class.

Commercially Sensitive Information Redacted

Table 5: Summary of EI&T systems broken down by type and network

4.3 Asset Age Profile

The following tables illustrate the total percentage of asset stock by year of install for EI&T assets. This enables us to give an overview of the asset install year profile which in turn allows us to identify the age profile of the assets.

The following table sets out a percentage view of asset install year of Electrical assets. The design life is typically 25 years.

Commercially Sensitive Information Redacted

Table 6: Year of asset install % by region: Electrical (Asset life circa 25 years)

Based on the data presented in Table 6, it is evident that the [sensitive data retracted] of electrical assets above the black threshold line have exceeded their typical designed service life of 25 years. Furthermore, an additional [sensitive data redacted] of these assets will reach or surpass their typical designed service life by the conclusion of the RIIO-3 period.

The following table sets out a percentage view of asset install year of instrumentation assets: The design life is typically 15 years.

Commercially Sensitive Information Redacted

Table 7: Year of install % by region: Instrumentation (Asset life circa 15 years)

Based on the data presented in Table 7, it is evident that [sensitive data redacted] of instrumentation assets above the black threshold line have exceeded typical designed service life. Furthermore, an additional [sensitive data retracted] of these assets will reach or surpass their typical designed service life by the conclusion of the RIIO-3 period.

The following table sets out a percentage view of asset install year of Telemetry assets. The design life is typically 10 years.

Commercially Sensitive Information Redacted

Table 8:Year of install % by region: Telemetry (Asset life circa 15 years)

Based on the data presented in Table 8 it is evident that [sensitive data redacted] of our Telemetry assets above the black threshold line have exceeded their typical designed service life. Furthermore, an additional [sensitive data redacted] of these assets will reach or surpass their typical designed service life by the conclusion of the RIIO-3 period.

When assets exceed their intended designed service life, operational efficiency may be maintained through routine maintenance and inspections, but the likelihood of non-repairable failures increases. This extended operation accompanied by a decline in the availability of readily obtainable replacement components, presents a heightened risk to the continued operation of the network.

Through RIIO-GD1 and RIIO-2, these assets have a rolling programme of inspections and maintenance, using the information gained from these we have invested in our EI&T systems, taking into consideration site criticality, asset age, supply chain and reliability. We intend to continue to invest in this way into RIIO-3, addressing asset reliability in the role EI&T plays in securing supply of gas to our customers.

4.4 Asset Condition Profile

The base data used in the asset health model is sourced from SAP, utilising a combination of the asset health index score, historical fault data, available spares through our supply chain, and validation through internal stakeholder engagement and SME engineering knowledge. It has enabled us to determine a current health score of our assets.

Below is a graph representation of the health score of our EI&T assets.

Commercially Sensitive Information Redacted

Figure 4: Condition Profile of Electrical Assets by Network

Commercially Sensitive Information Redacted

Figure 5: Condition Profile of Instrumentation Assets by Network

Commercially Sensitive Information Redacted

Figure 6: Condition Profile of Telemetry Assets by Network

The age and condition profile reveals that a significant portion of EI&T assets have surpassed their designed service life, with further assets projected to reach end-of-life within the RIIO-2 period. When assets exceed their typical life expectancy there is an increase in likelihood of failures and subsequent downtime due to lack of readily available spares. This combined with health scores of 4&5 across EI&T assets poses a potential risk to the network's reliability and resilience, and therefore increases our risk profile.

The below table is to summarise the assets which have a health score of 4&5 against the total asset population.

Commercially Sensitive Information Redacted

Table 9: Percentage of asset population with health score of 4&5 compared to total asset count

The above table indicates a difference between the EI&T asset health scores. The higher percentage of assets with risk scores of 4 & 5 is a direct consequence of their shorter maximum expected design life.

Assets with shorter design lives, particularly I&T, degrade faster. This accelerated degradation increases the likelihood of them reaching a higher risk state before being replaced, resulting in a larger proportion of assets falling into those higher risk categories.

Furthermore, rapid technological advancements create challenges for these assets. As surrounding technologies evolve, these assets may become difficult to interface with or support, effectively becoming obsolete even if they haven't reached the end of their physical lifespan. This obsolescence contributes to the higher risk profile of I&T assets.

While the percentage of high-risk assets is smaller in electrical assets, it is crucial to state that the absolute number of electrical assets is significantly greater than instrumentation and telemetry assets. This means that even a smaller percentage can translate to a substantial number of at-risk assets.

Therefore, neglecting electrical assets based solely on the percentage could leave a large number of critical components vulnerable to failure. This could lead to widespread disruptions and significant operational challenges, potentially outweighing the risks associated with the smaller number of high-risk I&T assets.

We are unable to provide a health score indication at the end of the RIIO-3 period as we currently do not model this asset family in AIM, however as part of our strategy we are targeting investment in systems which have a health score of 4 & 5 and pose the largest risk to our security of supply.

To mitigate the risks associated with failure and ensure uninterrupted service, pre-emptive investment is needed to ensure we reduce our risk profile.

5 Problem/Opportunity Statement

5.1 Why are we doing this work

Through our investment strategy, we expect to reduce the risk profile of this asset group. We seek to maintain our demonstrable safety and compliance record as well as ensure the operation of our Offtakes and PRSs does not contribute to any emissions.

Our EI&T systems compromise of deteriorating systems, we need to ensure that we manage these appropriately, and find a balance between customer expectations, cost, and feasible workload.

The drivers for investment in EI&T are:

- Mitigate the risk associated by asset deterioration and reduced reliability. Including adhering to specific regulatory requirements that directly affect EI&T
- Compliance: with the Network and Information Systems regulations (2018) (NIS), ensuring all future installations are compliant to the regulation

By investing in new technologies, we have the opportunity to enhance our operational efficiency, resilience, and reliability by integrating the below into our network:

- New EI&T Technologies: Unlock real-time network performance data. Proactively identify and address issues, boosting efficiency and safety
- Uninterruptible Power Supplies (UPS): Eliminate downtime. Safeguard critical equipment against power outages and fluctuations. Enhance safety and reliability, especially during extreme weather
- Integrating Renewable Energy Sources: Reduce reliance on the grid and lower our carbon footprint with solar and wind power. Boost sustainability and cut energy costs

This EI&T investment also presents an opportunity to install low-cost additional equipment when addressing asset health:

- Differential Pressure Transmitters: Continuously monitor pressure difference of filters. This data allows enables us to reduce unnecessary venting, reducing emissions, and minimising disruption to gas supply. It can contribute to optimising filter maintenance, leading to longer filter life and reduced costs.
- Flow Monitors: Allows for continuous, real-time data on gas flow within the network. Aiding in the ability pinpoint and locate leaks, optimising safety, and efficiency. Crucially, flow monitors also verify complete gas isolation before maintenance, protecting our workforce and the public.

By investing in EI&T we will directly continue to contribute to deliver against our RIIO-3 Environmental Action Plan (EAP) by:

- Reducing Offtake and PRS emissions by removing the need to vent as frequently

- Continue to reduce other direct emissions, by implementing more energy efficient technology
- Optimising pressure management with flow meters and more accurate sensors
- Provide accurate flow and pressure data to aid with decommissioning plans

5.2 What happens if we do nothing

[Commercially sensitive information – section redacted]

5.3 Key outcomes and understanding success

[Commercially sensitive information – section redacted]

5.4 Alignment with overall RIIO-3 investment strategy

[Commercially sensitive information – section redacted]

5.5 Narrative real-life example of problem

[Commercially sensitive information – section redacted]

5.5.1 Electrical example

Commercially Sensitive Information Redacted

Figure 7: Example: Distribution board: Electrical System

Figure 8: Example: Distribution board: Electrical System

Commercially Sensitive Information Redacted

Figure 10: Example: Lighting Electrical System

Figure 9: Example: [sensitive data retracted]. Exd Electrical System

5.5.2 Instrumentation and Telemetry

Commercially Sensitive Information Redacted

Figure 11: Example: [sensitive data retracted]. Telemetry systems

Figure 12: Example: [sensitive data retracted]. Keystone Hood PTX with new PTX after investment

Commercially Sensitive Information Redacted

Figure 14: Example: [sensitive data retracted]. Keystone hood PRS

Figure 13: Example: [sensitive data retracted]. Hazardous are Junction box

5.6 Project Boundaries

[Commercially sensitive information – section redacted]

6 Probability of Failure

[Commercially sensitive information – section redacted]

6.1 Failure modes

Commercially Sensitive Information Redacted

Table 10: Fault type and consequence for EI&T Assets

6.2 Failure rates for EI&T

Commercially Sensitive Information Redacted

Figure 15: Forecast Fault Rates of EI&T systems over time (Baseline: Reactive "Do nothing")

6.3 Probability of Failure Data Assurance

[Commercially sensitive information – section redacted]

7 Consequence of Fault or Failure

[Commercially sensitive information – section redacted]

7.1 Safety

[Commercially sensitive information – section redacted]

7.2 Security of Supply

[Commercially sensitive information – section redacted]

7.3 Environmental

[Commercially sensitive information – section redacted]

7.4 Future Energy Scenarios

[Commercially sensitive information – section redacted]

7.5 Monetised Risk

[Commercially sensitive information – section redacted]

Commercially Sensitive Information Redacted

Figure 16: Monetised risk (Repair cost + Probabilistic Run in Manual cost) for Baseline: Reactive "do nothing"

8 Options Considered

[Commercially sensitive information – section redacted]

8.1 Modes of intervention

[Commercially sensitive information – section redacted]

Commercially Sensitive Information Redacted

Table 11: Investment Options Overview

8.1.1 Repair of EI&T Assets

Commercially Sensitive Information Redacted

Table 12: Intervention Mode 1: Repair of EI&T assets on failure

8.1.2 Replacement of EI&T assets

Commercially Sensitive Information Redacted

Table 13: Intervention mode 2: Replacement of EI&T assets on failure

8.1.3 Full EI&T system replacement

Commercially Sensitive Information Redacted

Table 14: Intervention mode 3: Full replacement of EI&T system

8.2 Timing choices

8.3 Programme Options

Commercially Sensitive Information Redacted

Table 15: Intervention mode timing choices

Commercially Sensitive Information Redacted

Table 16: Initial Programme Options

8.3.1 Basis of Programme Volumes

[Commercially sensitive information – section redacted]

8.3.2 Basis of Unit Cost

[Commercially sensitive information – section redacted]

8.3.3 Programme option 1: Asset Health driven; pre-emptive system replace

Commercially Sensitive Information Redacted

Table 17: Key features: Programme option 1: Asset Health driven; pre-emptive system replace

8.3.4 Programme option 2: Asset Health driven; pre-emptive system replace (Constrained)

8.4 Technical Summary Table: Programme Options

Commercially Sensitive Information Redacted

Table 18: Technical summary of Investment options

9 Business Case Outline and Discussion

[Commercially sensitive information – section redacted]

9.1 Key Business Case Drivers Description

9.2 Business Case Summary

Commercially Sensitive Information Redacted

Table 19: Perceived value of each option as a business case

9.2.1 Discussion of results

9.2.2 Customer View and Willingness to pay

Commercially Sensitive Information Redacted

Figure 17: Monetised risk reduction of option 1 & 2 in comparison to baseline option

9.2.3 Sensitivity Testing

Commercially Sensitive Information Redacted

Table 20: Sensitivity Test Table

9.3 Conclusions

10 Preferred Option Scope and Project Plan

[Commercially sensitive information – section redacted]

10.1 Preferred Option

Commercially Sensitive Information Redacted

Table 21: Volume of EI&T system upgrades

Commercially Sensitive Information Redacted

Table 22: RIIO-3 Volumes of resilience and decarbonisation system types to be installed

Commercially Sensitive Information Redacted

Table 23: Volume of CNI UPS battery banks

Commercially Sensitive Information Redacted

Table 24: RIIO-3 Total Volume & Cost with total % contribution split

10.2 RIIO-3 Volume and Spend Profile

Commercially Sensitive Information Redacted

Table 25: Spend profile for EI&T interventions

Commercially Sensitive Information Redacted

Table 26: Volume profile for EI&T interventions

.

10.3 Investment Risk Discussion

Commercially Sensitive Information Redacted

Table 27: Investment risk discussion

CADENT - CONFIDENTIAL

10.4 Project Plan

[redacted]

Commercially Sensitive Information Redacted

Table 28: Programme of EI&T upgrades by PRS / Offtake

10.5 Key Business Risks and Opportunities

10.6 Outputs included in RIIO-2 Plans

11 Regulatory Treatment

12 Glossary

Term	Definition
CBA	Cost Benefit Analysis
EI&T	Electrical, Instrumentation and Telemetry
EJP	Engineering Justification Paper
FES	Future Energy Scenarios
FTE	Full Time Equivalent
NPV	Net Present Value
PRS	Pressure Reduction System
UPS	Uninterruptible Power Supply

Table 29: Glossary Table