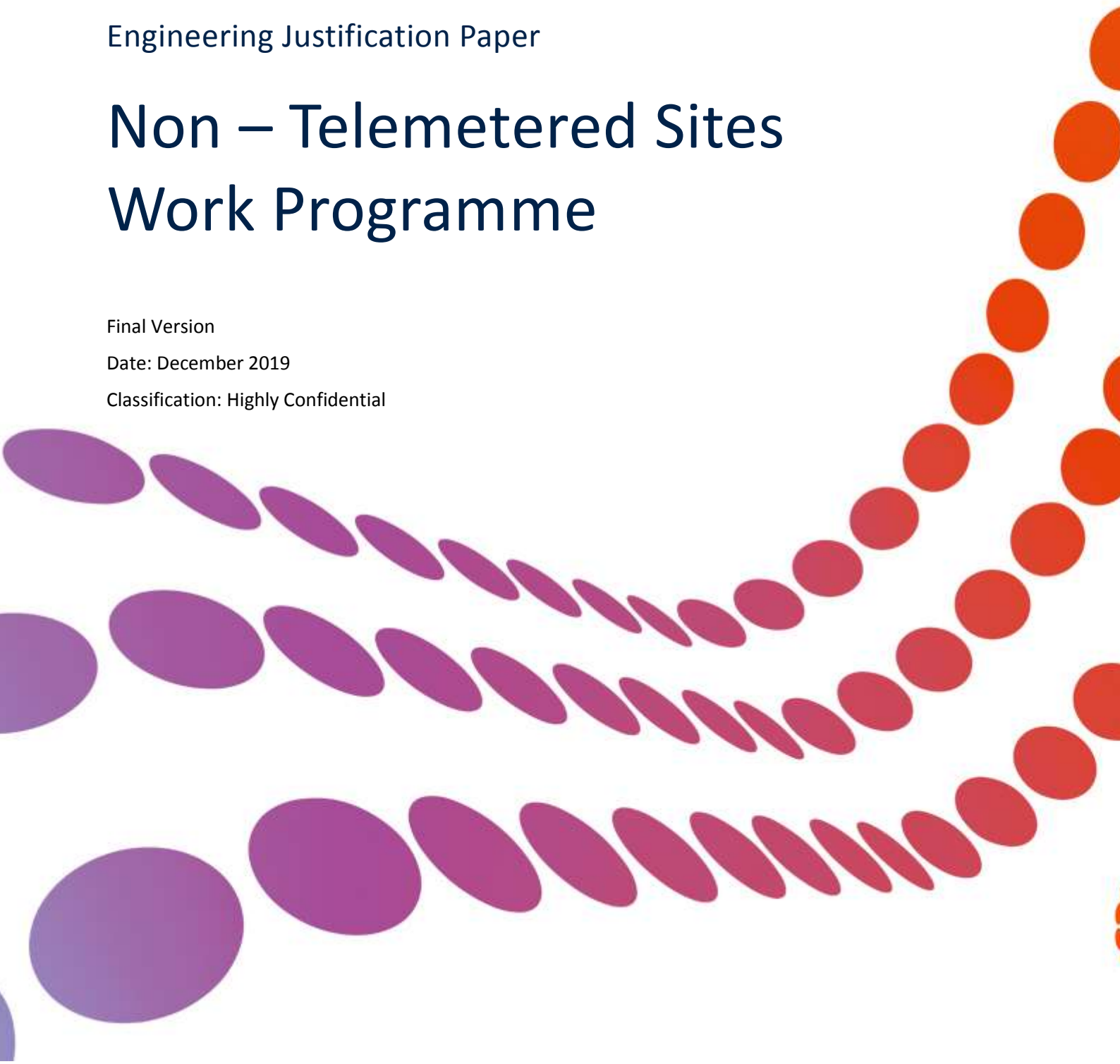
Engineering Justification Paper

Non – Telemetered Sites Work Programme

Final Version

Date: December 2019

Classification: Highly Confidential



1. Table of Contents

2 Introduction

This paper sets out SGN's investment proposal regarding non-telemetered Pressure Reduction Installations.

Across the Southern Local Distribution Zone (LDZ) SGN have 14 Pressure Reduction Installations (PRIs) which are not compliant with the recommendations of sections 10.2.1.5 and 10.2.3 of the recognised industry standard IGEM/TD/13. Also, recent developments in safety studies undertaken by SGN via Hazard and Operability study (HAZOP) / Layers of Protection Analysis (LOPA) have highlighted the possibility of a significant risk that could occur due to failure of meeting the recommendations of IGEM/TD/13.

2.1 General Background

These PRIs without telemetry have in the past suffered from power failures and heat loss resulting from device / system failures. The majority of these sites have also got single stream heating, thereby increasing the probability of freezing the regulator system due to the Joule-Thomson process and having a loss of supply.

2.2 Site Specific Background

This project will consider all 14 sites identified which do not have telemetry which were commissioned circa 1991. These sites all function in a similar manner with faults and consequences being consistent across the sites. Section 4.1 of this document provides a narrative of potential issues on site.

Table 1: Non-Telemetered Sites – operating parameters

S/N	Site name	Customers affected	Pressure tiers		Number of Streams	Number of boilers	Site Criticality
			Inlet (Bar(g))	Outlet (Bar(g))			
1	Chessington	1,587	41.8	2.1	2	1	Single supply – not integrated
2	Ellens Green	1,584	41.8	2.7	2	2	Single supply – not integrated
3	Etchinghill	707	41.8	2.7	2	1	Single supply – not integrated
4	Fletching	1,755	41.8	2.7	2	1	Single supply – not integrated
5	Freshfields	1,181	41.8	1.5	2	2	Single supply
6	Hawkhurst	3,810	41.8	2.7	2	1	Back fed another site
7	Hernfield	3,165	41.8	2.7	2	1	Back fed another site
8	Herne Hill	1,659	41.8	5.3	2	1	Single supply – not integrated
9	High Halden	1,291	41.8	2.7	2	1	Single supply – not integrated
10	Ockley	430	41.8	2.4	2	2	Back fed another site
11	Partridge Green	803	41.8	2.7	2	1	Single supply – not integrated
12	Peasmarsh	1,449	41.8	2.7	2	1	Single supply – not integrated
13	Petersfield	6,361	28.8	2.7	2	1	Single supply – not integrated

14	Smarden	881	41.8	2.7	2	1	Single supply – not integrated

3 Equipment Summary

Figure 1 below gives an overview of the site parameters on these non-telemetry sites. At present, SGN monitor remote sites with no telemetry by referencing local knowledge and following a standard approach which involves visiting each site once a week in the winter months and once a month when there is less demand on the network. The sites mentioned below are located within the Southern Network.

Figure 1: Non-Telemetered Sites – pressure tiers and stream redundancy

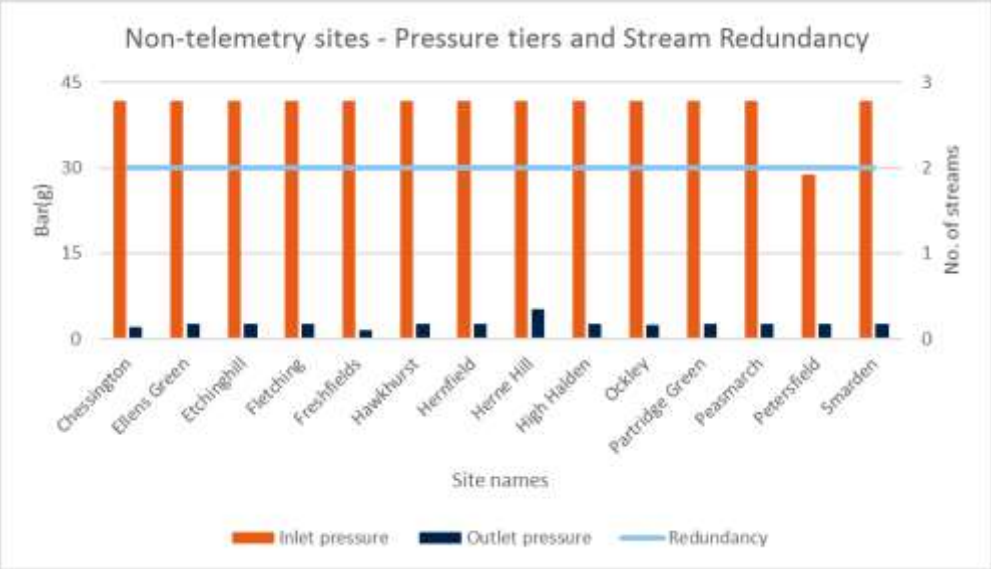
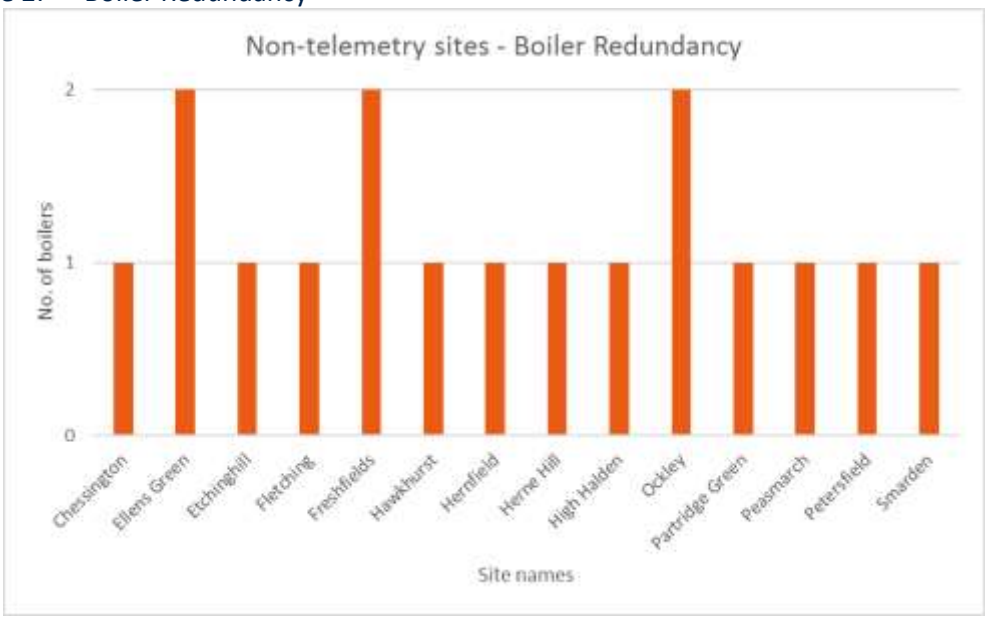


Figure 2 below shows the number of boilers which are on the Non-telemetry sites mentioned above. Each site has at least one boiler present, whilst Ellens Green, Freshfields and Ockley have two boilers due to the sites supplying a wider range of customers.

Figure 2: Boiler Redundancy



4 Problem Statement

Why are we doing this work and what happens if we do nothing?
The introduction of telemetry to these PRIs will significantly reduce the level of risk on these sites allowing SGN to remotely monitor the condition of these sites and proactively intervene where a fault occurs. This will provide recommended layers of protections as detailed in IGEM/SR/15 to demonstrate risks are "as low as reasonably practicable" (ALARP).

Failure to provide telemetry on these sites will increase the level of risk to employees and the public. Downtime to repair and fix issues onsite increases significantly, potentially leading to heavy fines, law suits, reputational damage, or an increase in operational cost.

What is the outcome that we want to achieve?
SGN aims to provide an uninterrupted supply of gas to consumers in a manner which is safe and reliable. To achieve this, SGN seeks investment to improve the risk to employees and the public by collecting data such as gas flows, inlet and outlet pressures, gas temperature, slam shut indication, etc. as stipulated in IGEM/TD/13 which will reduce downtime and support investment decisions.

How will we understand if the spend has been successful?
SGN will provide a network that is reliable with little disruption to the flow of gas to consumers. SGN will also be providing a Cost Benefit Analysis (CBA) to justify the investment for installing telemetry on all 14 sites identified.

At the end of RIIO-2 control period, these 14 nominated sites will have a fully functional telemetry system.

4.1 Narrative Real-Life Example of Problem

Occasionally, SGN sites experience power-cuts which can result in disruption to the safe delivery of gas if the situation is not attended to in a timely manner. The pictures below show the effect of pressure reduction (Joule-Thomson) on regulators captured on a PRI which lost power for a period. The effect of this is that cold gas will flow through the outlet of the site causing ground heaves and killing crops across farm land, it may also lead to stress on the downstream pipework because of temperature shock which might lead to pipeline fracture and/or fatalities.

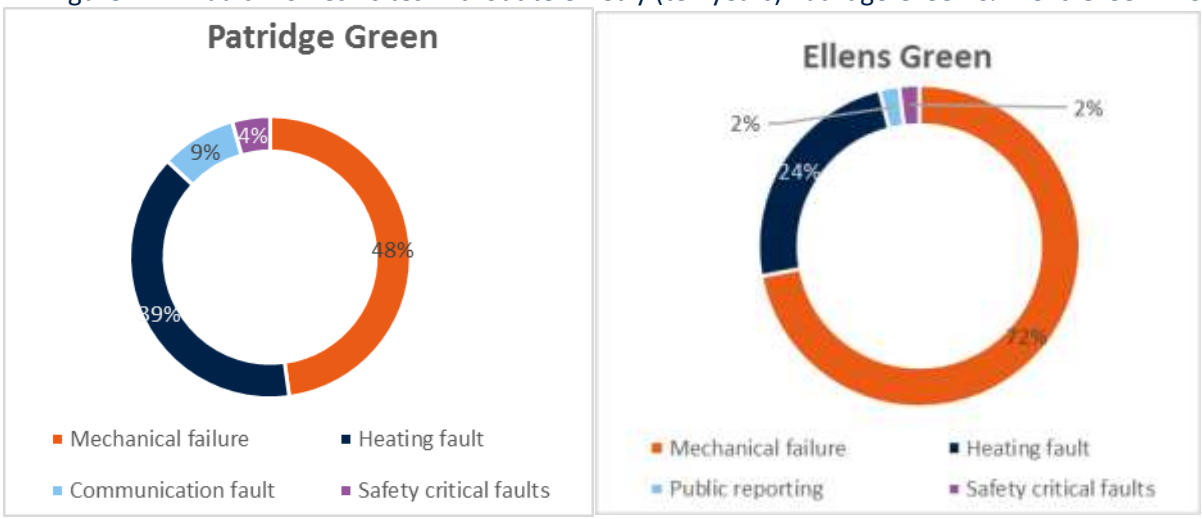
Figure 3: Wavendon PRS

Wavendon PRI - Wavendon is a village in the south east Borough of Milton Keynes and SGN is the gas transporter for this region. This site is not considered as part of the 14 sites identified in this paper because it is being considered under the mechanical RIIO-2 project proposal.

Not having telemetry onsite will be in contravention of the recommendations of IGEM/TD/13 (section 10.2.1.5 and section 10.2.3) which is a recognised gas industry standard. Failure to comply with this standard will result to being in contravention of the Health and Safety and Works Act etc. 1974.

Figure 4 below highlights the number of faults which have occurred at Partridge Green & Ellens Green over the past 10 years. Both sites follow a similar trend where mechanical failures have been the majority of faults.

Figure 4: Fault Profiles - sites without telemetry (ten years) Patridge Green & Ellens Green PRS



4.2 Spend Boundaries

The spend for this project will cover the design and installation of electrical infrastructures such as a telemetry unit and other associated ancillary equipment, civils works, housing for the telemetry and site documentation, etc. required to ensure compliance with sections 10.2.1.5 and 10.2.3 of IGEM/TD/13.

5 Probability of Failure

Over a 10-year period, SGN have recorded 20 failures on key safety elements across the 14 sites considered for telemetry installation in this paper. This has been compiled from the E&I Fault/1 forms, which have been completed by SGN's Operations team.

Using statistical analysis, these failures produced a Mean Time Between Failure (MTBF) of 4818 hours per failure. This means a slam shut system on these sites without telemetry will fail every 1.8 years.

5.1 Probability of Failure Data Assurance

The probability of failure data was derived from actual failures recorded onsite over a defined period. The MTBF analysis is a well-established technique for estimating failure rates. The MTBF is simply a calculation where the number of failures over the period the failures have occurred are taken into account to find out how often a failure will occur.

6 Consequence of Failure

The consequence of not having a telemetry system onsite can be catastrophic and potentially lead to fatalities.

Loss of Supply to Customers

In the event of a catastrophic failure such as pipe rupturing, customers will be left without gas for a very long period. This could affect hospitals, schools, care homes, local factories/business, and individuals. SGN will have to carry out a risk assessment of the damage and possibly use experts/structural engineers to assess the extent of the damage, provide emergency care to those affected by providing electric heater for example, mobilise workers to site to fix the problem, visits every home/establishment affected to purge the air trapped in the pipeline before commissioning. All these works could take an estimate of 6 to 8 weeks before completion.

Financially, after the first 24 hours, affected householders will be compensated for time without gas. Domestic customers will receive £41 for each 24-hour period without gas, small businesses will receive £69 for each 24-hour period without gas.

Safety Impact of Failure

If a mechanical failure occurred on site such as freezing of the regulators, there is a possibility of having 38bag gas flowing through a 2barg pipework which will result to asset damage, and possibly fatalities because of the slam shut system trying to compensate for pressure difference on the outlet of the network, forcing it to operate above its maximum operating pressure. This operation can occur for weeks stressing the network without being detected.

Environmental Impact

A pipeline rupture at 38barg has a potential of releasing up to 1500 standard cubic meter of gas per hour into the atmosphere. This will incur huge financial penalties from regulatory bodies, increases SGN's carbon footprint and will promote bad publicity for SGN.

Natural gas (Mostly methane) is a powerful greenhouse gas which is a significant contributor to climate change, as a large gas supplier SGN are determined to keep gas leaks to a minimum in order to reduce greenhouse gas emissions and avoid damage to vegetation and livestock.

7 Options Considered

Replace on Failure

This option does not apply because we have never had telemetry onsite, hence, there is nothing to replace on failure.

Repair on Failure

This option does not apply because we have never had telemetry onsite, hence, there is nothing to repair on failure.

Pre-emptively replace

Having telemetry onsite will reduce the level of risk at which we operate the gas network. It will provide an overview of the operation of each site to Gas Control Centre (GCC) ensuring that faults are detected and fixed in a timely manner. It is cost effective and ensures we comply with the recommendations of the gas industry standards.

Pre-emptively Repair

This option does not apply because we have never had telemetry onsite. Once telemetry is fully installed on these sites, SGN will monitor the performance of these devices and check to see if they can be pre-emptively repaired.

Do Nothing

The option of doing nothing onsite will expose SGN and customers to a high level of risk which is not acceptable. The financial and emotional consequence of having a catastrophic event can be very damaging to both SGN employees and the public.

Table 2: Consequence of failure costs

Category	Numbers	Greenbook methodology figures	Maximum Tolerable Individual Risk	PRI pipeline depreciation period in years	Resulting cost
Fatalities	2	£16,170,000	0.000001	45	£1,455.30
Non-fatal incidents	1	£185,000	0.000001	45	£8.33
Major offsite incident affecting water, supply, food chain, or housing for a period circa 1 month	1	£5,000,000	0.001	45	£225,000
Non-serious "nuisance" / odour incident	1	£50,000	0.01	45	£22,500
Total/site					£248,963.63
Total for South	14				£3,485,490.75

7.1 Do Nothing Option Summary

The technical detail of the option i.e. capacity, system rating, availability etc.

- Increased site visit to ensure safety
- Lack of human factors and ergonomics consideration

The basis for the cost estimate/unit cost

The cost estimate used for “doing nothing” is based on cost associated with the consequence of failure using estimates suggested in the Greenbook methodology and other industry recognised standards to demonstrate risk are “as low as reasonably practicable” (ALARP).

There is also an ongoing operational cost due to increased visits to site as they are not monitored on telemetry.

The perceived benefits of the option

The perceived benefits of doing nothing is very slim and not practical because the risk outweighs any potential savings.

Delivery timescales

This section is not applicable and cannot be considered for this project, also the doing nothing option is to operate as is.

Key assumptions made

- High failure rates
- Increase in operational cost

Any other items that differentiate the option from the others considered

- Safety case studies
- Recognised industry standard recommendations

7.2 Pre-emptively Rebuild

The technical detail of the option i.e. capacity, system rating, availability etc.
The introduction of a telemetry system will:

- Ensure SGN meets the recommendations of the recognised industry standards
- Enable SGN use innovative ideas to improve the gas network
- Aid ALARP demonstration
- Boost efficiency

The basis for the cost estimate/unit cost
The cost estimates are based on previous telemetry projects and costings from project managers. Ancillary cost was included to facilitate other works onsite such as civils, telemetry housing, drawings, relocation of supply cables, etc.

The perceived benefits of the option
The benefit of installing telemetry systems across these 14 sites ensures GCC have an overview of the situations onsite and enable operatives attend to fault effectively.

Delivery timescales
SGN aims to deliver an average of 3 telemetry installations per year. Agreement have been reached with all stakeholders to ensure the timely delivery of this project.

Key assumptions made

- Improved safety
- Improvement of the integrated gas network

Any other items that differentiate the option from the others considered

- Consequence of failure as described in section 6 of this document

7.3 Options Technical Summary Table

Table 3: Options Technical Summary

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment / Investment Design Life	Total Cost
Do Nothing (CAPEX)	2022	2022	0	25	0.00
Pre-emptively Install	2022	2026	14	25	1.54

7.4 Options Cost Summary Table

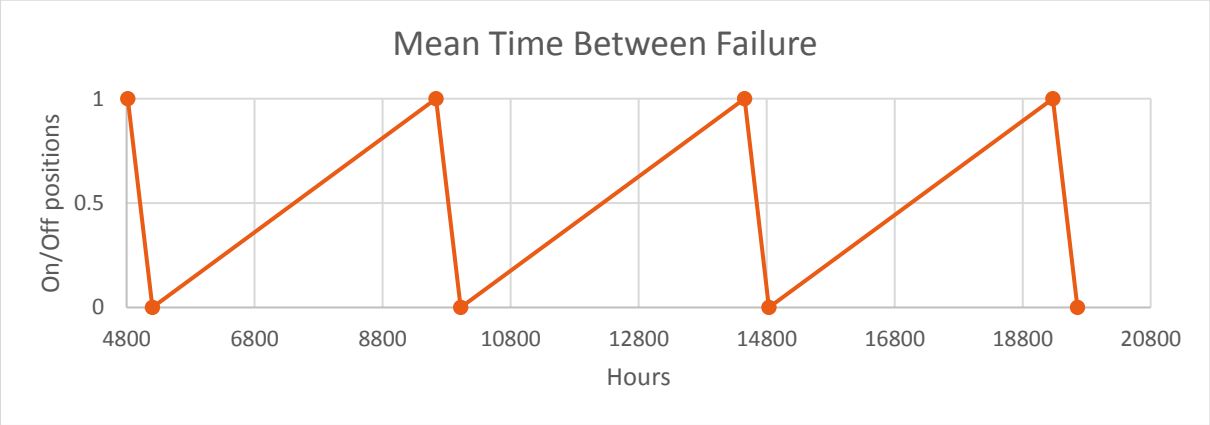
Table 4: Cost Summary

Option	Cost Breakdown	Total Cost (£m)
Pre-emptively Rebuild	Please see Appendix B for detailed cost breakdown	£1.54m Gross
Do Nothing	This option has £0 capex costs. This is made up from carried risk costs (table 2 of EJP) and Callout Maintenance costs of £32,300 per annuum.	£0 capex

8 Business Case Outline and Discussion

It is estimated that a fault on the slam shut will occur on a PRI without telemetry at a frequency of 200.75 days per failure with a mean downtime of 16 hours.

Figure 5: MTBF for Non-Telemetered Sites



Doing nothing on these 14 sites and maintaining the status quo will result to increase in operational cost and an unacceptable level of risk as detailed in IGEM/SR/15 to SGN employees and gas consumers.

8.1 Key Business Case Drivers Description

Table 5: Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	Replace on Failure	This option is not possible as there is currently no telemetry on site.
2	Repair on Failure	This option is not possible as there is currently no telemetry on site.
3	Pre-emptively Replace (Rebuild)	• Statutory / Regulatory compliance • Efficiency • Safety (demonstrating ALARP) • One off cost for design and appraisals • Reduced operational cost • Reduced probability of failure
4	Pre-emptively Repair	This option is not possible as there is currently no telemetry on site.
5	Do Nothing	• Inefficiency • Reactive measure to safety as opposed to pre-emptive measures • Not economical • Prolonged downtime

Table 6: Summary of CBA Results

NPVs based on Payback Periods (absolute, £m)								
Option No.	Desc. of Option	Preferred Option (Y/N)	Total Forecast Expenditure (£m)	Total NPV	2030	2035	2040	2050
Baseline	Do Nothing	N	-0.16	-3.52	-0.84	-1.27	-1.67	-2.37
1	Pre-emptively Install Absolute NPV	Y	-1.54	-2.03	-1.11	-1.23	-1.31	-1.73
1	Pre-emptively Install NPV relative to Baseline	Y	-1.54	-2.03	-0.27	0.04	0.36	0.64

8.2 Business Case Summary

The introduction of a telemetry system will ensure SGN meets the recommendations of the recognised industry standards mentioned previously in this report and enable SGN use innovative ideas to improve the gas network communications network. With the introduction of telemetry on site, this will aid ALARP demonstration and boost efficiency within SGN OPEX cost and carbon footprint due to reduced travel and visits to site. The benefit of installing telemetry systems across these 14 sites ensures GCC have an overview of the situations onsite and enable operatives attend to fault effectively outweigh the operational costs of the 'do nothing' option.

Table 7: Business Case Matrix

	Pre-emptively Install
GD2 Capex (£m)	1.54
Number of Interventions	14.00
Carbon Savings ktCO2e (GD2)	0.00
Carbon Savings ktCO2e /yr	0.00
Carbon Emission Savings (35yr PV, £m)	0.00
Other Environmental Savings (35yr PV, £m)	0.00
Safety Benefits (35yr PV, £m)	2.13
Other Benefits (35yr PV, £m)	0.00
Direct Costs (35yr PV, £m)	-1.30
NPV (35yr PV, £m)	0.83
High Carbon Scenario	
Carbon Emission Savings (35yr PV, £m)	0.00
High Carbon NPV (35yr PV, £m)	0.83

9 Preferred Option Scope and Project Plan

9.1 Preferred option

The preferred option considered for the RIIO-2 period is to install suitable telemetry systems onsite to create a safe working environment to employees, prolong assets, and ensure SGN meets the recommendations of IGEM/SR/15 and IGEM/TD/13.

9.2 Asset Health Spend Profile

Table 8: Spend Profile

Asset Health Spend Profile (£m)					
Pre-emptively Install	2021/22	2022/23	2023/24	2024/25	2025/26
South of England LDZ	0.32	0.30	0.30	0.30	0.33

9.3 Investment Risk Discussion

Risk Matrix

Table 9: Risk Register

Risk Description	Impact	Likelihood	Mitigation/Control
Budget	Overspend	≤20%	This could be as a result of unforeseen issues on site when the work begins, or the footprint of the new telemetry systems not being suitable for site. Some of these sites will require only a low-cost telemetry solution (Tier 3) as opposed to the more expensive option (Tier 1 and 2). SGN will ensure to correctly identify these sites before commencing project work. All Tier 1 to 5 sites have all been identified. This should allow flexibility in case there is any over spend issues.
Resource	Delayed	>20% & ≤40%	As there is a large workload in GD2, it is a risk that SGN will not have a resource to deliver this workload. To mitigate against this, this program of works will be delivered by the E&I Operations Project team as opposed to Major Construction Projects.

CAPEX Sensitivity

Table 10: Sensitivity Results

	South of England LDZ's		
	Low	**Mid**	**High**
GD2 Capex (£m)	1.39	1.54	1.85
Number of Interventions	14	14	14
Carbon Savings ktCO2e (GD2)	-	-	-
Carbon Savings ktCO2e /yr	0	0	0
Carbon Emission Savings (35yr PV, £m)	0.0	0.0	0.0
Other Environmental Savings (35yr PV, £m)	0	0	0
Safety Benefits (35yr PV, £m)	2.1	2.1	2.1
Other Benefits (35yr PV, £m)	0.0	0.0	0.0
Direct Costs (35yr PV, £m)	-1.3	-1.3	-1.4
NPV (35yr PV, £m)	0.9	0.8	0.8

Project payback has not been carried out as part of this analysis due to the effect of the Spackman approach. For a cash-flow traditional project payback period please see scenario 4 of our Capitalisation Sensitivity table.

Network E&I believe the preferred option is pre-emptive replace. For the purpose of sensitivity analysis, the following has been applied to the preferred option of pre-emptive replacement:

Low Case: SGN have applied a reduction of 10% CAPEX costs – this can be applied if SGN achieve greater than expected discounts on material purchase and also if greater efficiencies can be achieved in projects delivery that haven't already been fed into the costs – this would be process improvements and streamlining working practices to reduce mobilisation time on site.

Mid Case: no changes have been applied, this is the expected output required for the GD2 time period.

High Case: SGN have applied an additional 20% on the CAPEX expenditure, as this is believed to be the potential cost increase if SGN do not go to tender and achieve best possible market prices. This could also be impacted by political changes which may impact on resource availability or material costs. This increase in cost also allows for any issues in obtaining generic designs for the full volume of works or SGN not being able to delivery these projects efficiently due to internal processes which would increase contract labour costs.

Capitalisation Sensitivity

Consumers fund our Totex in two ways – opex is charged immediately though bills (fast money – no capitalisation) and capex / repex is funded by bills over 45 years (slow money – 100% capitalisation). The amount deferred over 45 years represents the capitalisation rate. Traditionally in 'project' CBA's the cashflows are shown as they are incurred (with the investment up front which essentially is a zero capitalisation rate). Therefore, we have developed scenarios that reflect both ways of looking at the investment – from a consumer and a 'project'.

The scenarios are summarised as follows:

- Scenario 1 - we have used the blended average of 65%, used in previous iterations of this analysis.
- Scenario 2 - we have represented the Capex and Opex blend for the two networks, as per guidance.
- Scenario 3 - addresses our concerns on capitalisation rates whereby Repex and Capex spend is deferred (100% capitalisation rate) and Opex is paid for upfront (0% capitalisation rate).
- Scenario 4 - this reflects the payback period in 'project' / cash-flow terms and provides a project payback.

We have taken a view of the NPV in each of the scenarios, with the exception of scenario 4, at the 20, 35 and 45 Year points, to demonstrate the effect of Capitalisation Rate on this value.

Table 11: Capitalisation Rate Sensitivity Results – South of England

Scenario	1	2 SO	3	4
Capex (%)	65	38	100	0
Opex (%)	65	38	0	0
Repex (%)	100	100	100	0
Output				
NPV (20yr PV, £m)	0.45	0.42	0.69	
NPV (35yr PV, £m)	1.28	0.83	1.12	
NPV (45yr PV, £m)	1.81	1.28	1.39	
Payback	11.00	13.00	0.00	15.00

Appendix A - Commercial Confidentiality

Appendix B - Acronyms

Acronym	Description
CBA	Cost Benefit Analysis
GCC	Gas Control Centre
HAZOP	Hazard and Operability study
LDZ	Local Distribution Zone
LOPA	Layers of Protection Analysis
MTBF	Mean Time Between Failure