Engineering Justification Paper

Ulysses Telemetry Replacement Programme

Final Version

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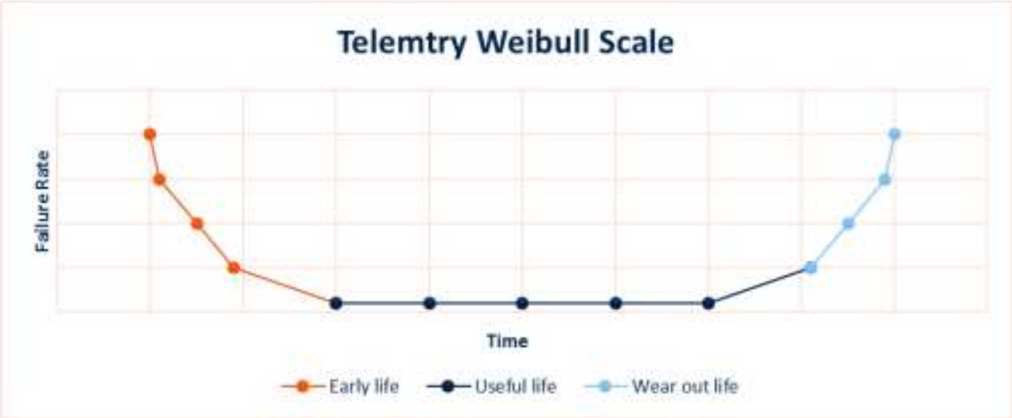
2 Introduction

This paper sets out SGN's investment proposal for investment regarding telemetry systems.

SGN's Ulysses telemetry system was introduced in 1999 as a turnkey project to commence the replacement of SGN's remote site telemetry systems which is part of the Gas Transportation Management System (GTMS). By the start of the GD2 RIIO-2 programme in 2021 these Ulysses (Remote Telemetry Unit (RTU)) telemetry devices would have been in service for 22 years.

Figure 1: Telemetry Weibull Scale over a 20 year period



2.1 General Background

The Health and Safety Executive (HSE) research report series 823 – Managing Ageing Plant recommends that the lifetime of Electronic, Control, and Instrumentation system can be taken to be 15 to 20 years. The document further highlighted that 60% of major hazard loss of containment incidents were related to technical integrity and, of those, 50% have ageing as a contributory factor. It is therefore concluded that asset ageing mechanisms are significant factors to consider in avoiding hazards.

The United Kingdom's Network and Information Systems Regulation 2018 (NIS Regulations) mandated all Operators of Essential Services (OES) to ensure appropriate and proportionate technical and organisational measures to manage the risk posed to the security of network and information systems. The competent authorities could fine defaulters up to a maximum fine of £17 million in the United Kingdom.

2.2 Site Specific Background

Over the last 5 years there has been a steady increase in the number of communication failures especially with the RTU and its associated Elcon safety input/output (I/O) barriers. These devices are difficult to replace because they are no longer supported by the manufacturers and spares are generally difficult to purchase or replace with an equivalent due to equipment footprints.

The workload considered for this project incorporates both Southern and Scotland Network. For RIIO-2 price control period, 165 sites will be considered to ensure the telemetry systems are fully functional and meets the requirement of relevant industry standards.

3 Equipment Summary

Between Southern and Scotland Local Distribution Zones (LDZ) SGN has a total of 165 operational aged RTUs of which SGN's Pressure Reduction Installations (PRIs) accounts for about 93% of the total amount.

The RTUs work continuously to ensure data is transmitted from remote operational sites such as National Transmission Sites (NTS) Offtakes with inlet pressure ranging from 50bag to 70barg and PRIs with a typical inlet pressure ranging from 7barg to 38barg to SGN's Gas Control Centre (GCC). The data transferred (see appendix for types of data collected on site) from the outstations are used to manage the SGN gas supply networks across both LDZs.

Redundancy Architecture of the RTU

Across SGN, there are two groups of communication strategies which uses various parameters to determine the applicable redundancy architecture. These are Network Entry Points (NEP) and Integrated Networks (IN).

Network Entry Points such as NTS Offtakes operates a Dual Modular Redundancy (DMR) communications architecture such that a satellite communication system is used as the primary means of data communication with a dial-up back-up line as a secondary communication channel to transfer data between remote sites and SGN's GCC to reduce the impact of a common mode failure.

The Integrated Networks such as PRIs do not have DMR as they operate on a single mode of communication which could be satellite, Ultra High Frequency (UHF) radios, or other public service networks.

4 Problem Statement

Why are we doing this work and what happens if we do nothing?

These aged telemetry systems are now within the end of life region of the product lifecycle. The manufacturers of these aged telemetry systems cannot support repairs or provide spares. In addition to this, the software configuration for these aged RTUs is subject to ageing operating system(s) with little support or competent personnel within the industry that can configure these aged systems.

As an operator of essential services, SGN has an obligatory requirement to ensure appropriate and proportionate technical and organisational measures to manage the risk posed to the security of network and information systems. SGN will use IEC 62443 as a guideline for mitigating against the risk of failure and exposure of Industrial Control Systems network from cyberthreats.

SGN typically uses telemetry to monitor site status of filters, inlet and outlet pressure, inlet and outlet flows, heater status, reliefs, slam shut systems, valve position adjustments, etc. to facilitate site control such as set point control to direct valve control, security breach, etc. on remote outstations.

Failure to adequately monitor the gas network with a reliable telemetry system would not support the recommendations detailed within IGEM/TD/13 (section 10.2.1.5 and section 10.2.3) which is the recognised gas industry standard.

What is the outcome that we want to achieve?

SGN aims to replace aged RTUs and associated Elcon safety I/O barriers across the Southern and Scotland LDZs with a device which can deliver reliable communication between the outstations and GCC. This device will be easy to implement and provide all the functionality provided by the aged telemetry device. The replacement device will conform to IEC-61131-3 and meet the requirements of Electromagnetic Compatibility (EMC) Directive (2014/30/EU) and Radio Equipment Directive (2014/53/EU).

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 use a Cost Benefit Analysis (CBA) to justify the investment for replacing the aged telemetry system across the Southern and Scotland LDZs.

At the end of RIIO-2 price control period, SGN will have completed the replacement of 165 RTUs ensuring compliance with current standards and safety practices.

4.1 Narrative Real-Life Example of Problem

Blean Pressure Reduction Installation (PRI) is in the Canterbury district of Kent feeding approximately 17,000 households. Between the years of 2017 and 2018 there were 3 major faults recorded at this site. As a narrative, there was a heating system failure reported to SGN Gas Control Centre (GCC) via telemetry which provided SGN with an instantaneous overview of the fault onsite allowing operatives to attend site within a short period of time to fix the fault.

Failure to address this issue could have potentially led to freezing of the pressure regulator system or damage to the downstream infrastructure (which is caused by the Joule-Thomson effect), thereby leading to a possible loss of supply to consumers.

The telemetry scans the site for information such as gas temperature, gas flows, slam shut (safety over pressure device) indications, etc. If a major issue were to occur on an outstation such as a terrorist attack and the RTU at that outstation were to fail causing communication disruption between the outstation and GCC, we could experience a loss of supply to consumers and a possibility of having a catastrophic incident.

4.2 Spend Boundaries

This project will cover the replacement of the existing aged telemetry systems including UHF radios and Hilltops electronic devices and its associated safety barriers with a suitable telemetry system available to SGN at the point of installation.

5 Probability of Failure

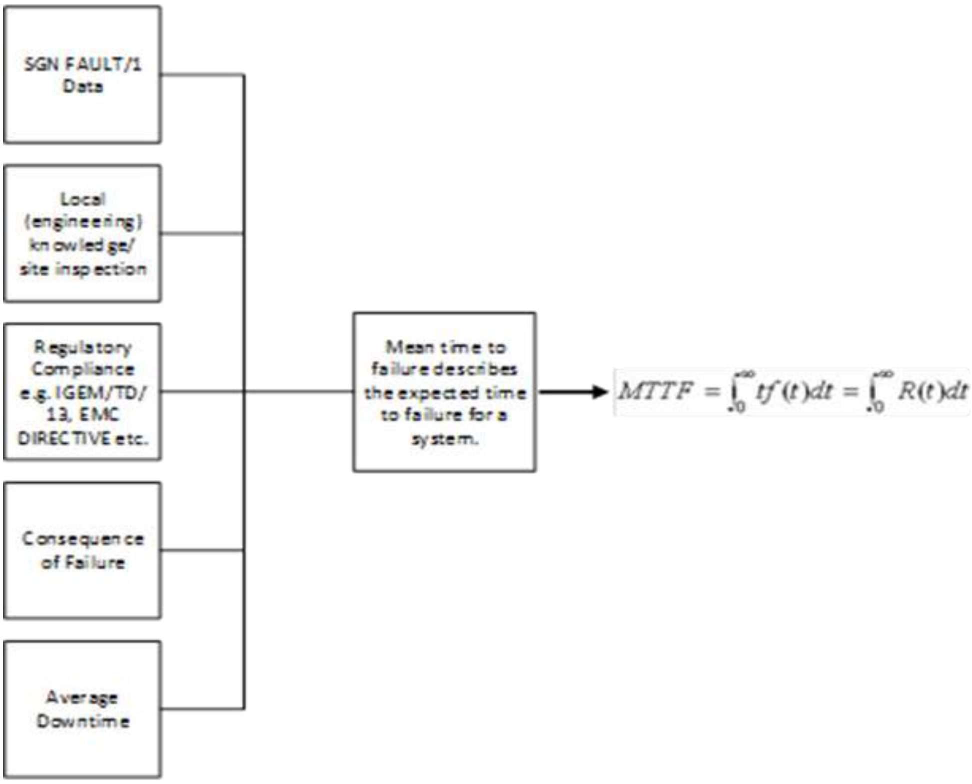
Over a 5-year period SGN recorded 158 faults on telemetry systems across 83 sites. Using these data, it is estimated that the Mean Time to Failure (MTTF) is 527.7 hours per failure. This equates to 16.6 faults per year.

5.1 Probability of Failure Data Assurance

The probability of failure data used was gathered from recorded faults and analysed using proven statistical analysis to determine the probability of failure.

MTTF was used because it fits the working principle of the telemetry system. This is highlighted in the figure below, which shows the means of how MTTF is calculated. In order to calculate MTTF, various data sources have been acquired, most of which has been acquired through Fault/1 forms and information gathered from E&I Operations.

Figure 2: Data Source



6 Consequence of Failure

Loss of Supply to Customers
The consequence of having a telemetry or communications failure can be catastrophic if not addressed in a timely manner. Telemetry helps to reduce the risk of a hazard occurring (such as loss of supply to customers) by providing GCC with situational awareness and network visibility of remote sites to maximise optimum operation of the networks. Essentially if SGN lose telemetry on site and a major issue arises, GCC would lose 'eyes' on the site and would be unaware as to what the impact to customers would be.

An analysis was carried out for Broxburn Offtake which supplies a large number of customers within the Edinburgh area. Broxburn currently supplies gas to over 200,000 customers, therefore the criticality to keeping gas flowing through this site is paramount. Broxburn currently supplies 7 PRS's, which include Granton (City and Forth). Turnhousce, Fairmilehead, Bole-o-Bere, Winchburgh, Swanston, Straiton. In the event of losing telemetry and a major issue occurred which seized gas flow, then supply to both Granton City/Forth and Fairmilehead would come to a halt. The number of customers that would be affected by this is 137,468. This would have an extensive impact on the public and therefore it is essential that telemetry sites are kept running efficiently at all times.

Safety Impact of Failure
The telemetry monitors many parameters as described in IGEM/TD/13 (section 10.2.1.5 and section 10.2.3) which ensures notification of site issues before major problems occurs. It provides GCC with situational awareness, network visibility, and enables optimum operation of the gas network.

If GCC lose contact with site, it is impossible to know whether a major incident has occurred. In the case of losing telemetry and the possibility of a major gas leak occurring, SGN will be unable to react and shut off gas supply swiftly. If a gas escape occurs undetected this could have a real harmful effect on the general public.

Environmental Impact
If the telemetry system were to breakdown at an outstation i.e. NTS and a major incident were to occur such as damage to the pipeline, SGN will lose the ability to isolate the supply of gas remotely, increasing the chance of a substantial discharge of natural gas into the atmosphere without control.

In terms of quantifying the potential amount of gas released is difficult as a number of factors must be considered. This will include the location within the network, the amount of gas being released within the atmosphere and also the duration that the gas has been leaking. Therefore, to put exact numbers on this is unattainable.

7 Options Considered

Replace on Failure

Replacement on failure is the strategy currently utilised by SGN to manage these aged RTUs. This involves using spares from decommissioned projects or total revamping of the telemetry system to manage RTU failures across SGN gas network.

This process is very expensive and inefficient to adequately support the gas network. This process is reliant on the availability of quick turnovers in design appraisals and installation. If not managed correctly, it may lead to complications on critical devices or prolonged downtime of the gas network.

Category	Numbers	Greenbook methodology figures	Maximum Tolerable Individual Risk	PRI pipeline depreciation period in years	Resulting cost
Fatalities	2	£16,170,000	0.000001	25	£808.50
Non-fatal incidents	1	£185,000	0.000001	25	£4.625
Major offsite incident affecting water, supply, food chain, or housing for a period circa 1 month	1	£5,000,000	0.001	25	£125,000
Non-serious "nuisance" / odour incident	1	£50,000	0.01	25	£12,500
Total/site					£138,313.125
Total for Scotland	81				£11,203,363.13
Total for South	40				£11,618,302.50

The sum of £22,821,665.63 is the estimated benefit of eliminating potential hazards across 165 sites over a period of 25 years based on avoidance of causalities. The figures used in this calculation have been obtained from IGEM/SR/15 and the Greenbook model.

Repair on Failure

Repair on failure is difficult to achieve because the manufacturers of the RTUs no longer supports this device. For example, the footprint of newer Profibus card does not fit the MM4T-A RTU. In addition to this, there is no assurance that RTU will function as intended if repaired. This will incur a high cost as multiple failures could occur, resulting to frequent operative intervention or total revamp of the telemetry system.

Pre-emptively replace

This option is the most efficient strategy to reduce communication downtime and increases data reliability between GCC and remote SGN sites. This is a systematic approach which is safe, easy to manage, and cost effective.

This option aims to replace these aged RTUs with a robust and eco-friendly telemetry system that will conform to IEC-61131-3 and meet the requirements of Electromagnetic Compatibility (EMC) Directive (2014/30/EU) and Radio Equipment Directive (2014/53/EU).

Pre-emptively Repair

Pre-emptive repair is difficult to achieve because there is no medium of predetermining faults on the RTU. This option is practically impossible to achieve.

Do Nothing
SGN's GCC relies on the telemetry system to provide information to effectively balance supply and demand. The telemetry also provides information which SGN GCC uses to minimise the escalation of minor incidents.

The effect of doing nothing may lead to incidents as the rate of telemetry failures is steadily increasing with limited spares available.

7.1 Replace on Failure Option Summary

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

- These RTUs were designed as a non-repair device with an average lifespan of 15 to 25 years
- Spares held are not reliable, and the manufacturers cannot provide support
- These RTUs do not meet industry recommendations such as IEC-61131-3, EMC Directive (2014/30/EU), etc.
- These RTUs are more susceptible to cyberthreats compared to the devices available today

The basis for the cost estimate/unit cost
The cost estimate used for replacement of telemetry upon failure was 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).

The unit cost for replacing a telemetry system on site for an ad-hoc project for an offtake was £70,000 and for a pressure reduction station was £56,000. The costs were for previous GD1 works and broken down further below in the report.

The perceived benefits of the option
Replacement of telemetry upon failure bares no benefit to SGN because of the implications of telemetry failure. See section 4 above (Problem statement).

Delivery timescales
The delivery and timescales for replacing telemetry upon failure will vary with respect to the nature of the fault. For example, SGN allows for a 2-hour response time to site in the event of a telemetry failure. On arrival to site, SGN operatives will assess the situation and try to remediate the problem (typically 2 to 4 hours). Where the problem persist, SGN operatives will seek replacement with a spare device where available or seek a suitable replacement which will involve design, end-to-end testing, software upgrades, etc. (this process could last between a period of 4 to 12 weeks).

Key assumptions made

- This process is not cost effective
- SGN is susceptible to huge fines from regulators in the event of a major incident
- Cyberthreats are high

Any other items that differentiate the option from the others considered
These RTUs are:

- Obsolete
- Are past their useful like and well into the wear out lifecycle stage

7.2 Pre-emptively Replace Option Summary

The technical detail of the option i.e. capacity, system rating, availability etc.
The replacement of existing telemetry with newer technology provides:

- Stability and high reliability of communication
- Drives innovative ideas to optimise customer satisfaction
- Meets all applicable regulatory standards
- Energy efficient (low carbon footprint)

The basis for the cost estimate/unit cost
The cost estimates provided in this paper with respect to pre-emptive replacement of the existing telemetry units are based on a combination of resources provided from designers, industry experts and SGN personnel. It considers cost savings utilising a custom design which apply to all existing designs considered for replacement. For an offtake the unit cost for a Ulysses replacement as part of a larger package of works is £50,000 and for a pressure reduction station is £40,000.

The perceived benefits of the option
This option cuts down the design process because a one-off custom design will be utilised. This will enable SGN focus on the delivery of the project effectively. Also, this option is cost effective (33% cost savings when compared to replacement on failure) and provides reassurance of reliable communication between SGN outstations and GCC.

Delivery timescales
SGN aims to deliver an average of 33 RTU replacement projects per year which accounts for 20% of the overall project over a 5-year period.

Key assumptions made
- SGN will meet all applicable regulatory standards and demonstrate ALARP
- One off cost for design and appraisals
- Scheduled replacement over a period
- Reduced operational cost
- Reduced probability of failure
- Cost effective

Any other items that differentiate the option from the others considered
- The new RTUs will have a working lifecycle spanning an average of 15 to 20 years.
- Less susceptibility to cyberthreats

7.3 Options Technical Summary Table

Table 1: Options Technical Summary

Option	First Year of Spend	Final Year of Spend	Volume of Interventions	Equipment / Investment Design Life	Total Cost
Scotland LDZ					
Replace on Failure	2022	2026	155	25	6.64
Pre-emptively Replace	2022	2026	155	25	4.47
South of England LDZ's					
Replace on Failure	2022	2026	208	25	7.07
Pre-emptively Replace	2022	2026	208	25	4.96

7.4 Options Cost Summary Table

Table 2: Cost Summary

Option	Cost Breakdown	Total Cost (£m)
Pre-emptively replace	Please see Appendix E for detailed cost breakdown. High level: Offtake Replacement - £50,000 PRS Replacement - £40,000 UHF Radio replacement - £3,000 Hilltop refurbishment(1) - £35,000 Please see appendix D for detailed cost breakdown.	Scotland £4.47m Gross South of England £5.0m Gross
Replace on failure	Please see Appendix E for detailed cost breakdown. High level: Offtake Replacement - £70,000 PRS Replacement - £56,000 UHF Radio replacement - £3,000 Hilltop refurbishment- £35,000	Scotland £6.64m Gross South of England £6.8m Gross

8 Business Case Outline and Discussion

It is estimated that a telemetry unit will fail to communicate with GCC for a period of 527.7 hours per year as shown below.

Figure 3: MTTF based on sample population of 83 sites with 158 failures (5 year period)

Doing nothing and maintaining the status quo is not sustainable going into RIIO-2 price control period because of the steady increase in faults. Also repairing the telemetry unit is not feasible and does not provide confidence of optimum functionality where applicable. The most viable option is to pre-emptively replace the aged telemetry devices to meet the requirements of IGEM/TD/13.

8.1 Key Business Case Drivers Description

Table 3: Summary of Key Value Drivers

Option No.	Desc. of Option	Key Value Driver
1	Replace on Failure	• Inefficiency • Reactive measure to safety as opposed to pre-emptive measures • Cost • Prolonged telemetry downtime • Not economical • Working life span exceeds the recommendations of the HSE
2	Repair on Failure	Option is not possible as the units cannot be repairs
3	Pre-emptively Replace	• Statutory / Regulatory compliance • Efficiency • Safety (demonstrating ALARP) • One off cost for design and appraisals • Scheduled replacement over a period • Reduced operational cost • Reduced probability of failure
4	Pre-emptively Repair	Option is not possible as the units cannot be repairs
5	Do nothing	Not a viable option due to license requirements.

Table 4: 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**
Scotland LDZ								
Baseline	Replace on Failure	N	-6.64	-12.07	-6.35	-6.99	-7.43	-9.86
1	Pre-emptively Replace Absolute NVP	Y	-4.47	-5.86	-3.01	-3.43	-3.71	-4.87
2	Pre-emptively Replace NPV relative to Baseline	Y	-4.47	-5.86	3.34	3.56	3.72	4.99
South of England LDZ's								
Baseline	Replace on Failure	N	-7.07	-12.79	-7.05	-7.61	-8.00	-10.64
1	Pre-emptively Replace Absolute NPV	Y	-4.96	-6.52	-3.57	-3.95	-4.21	-5.55
2	Pre-emptively Replace NPV relative to Baseline	Y	-4.96	-6.52	3.48	3.66	3.79	5.09

8.2 Business Case Summary

This project is driven by the potential for loss telemetry on multiple sites for a prolonged period of time due to the age profile and spares availability of the existing telemetry infrastructure. Ad discussed previously in this paper, telemetry monitors key parameters on site such as gas pressure, temperature and flow back to gas control. The pre-emptive replacement option has been evaluated as the most cost effective and manageable solution to this.

Table 5: Business Case Matrix

	Pre-emptively Replace	**Pre-emptively Replace**
	Scotland	South of England
GD2 Capex (£m)	4.47	4.96
Number of Interventions	155	208
Carbon Savings ktCO2e (GD2)	0.00	0.00
Carbon Savings ktCO2e /yr	0.00	0.00
Carbon Emission Savings (35yr PV, £m)	0.00	0.00
Other Environmental Savings (35yr PV, £m)	0.00	0.00
Safety Benefits (35yr PV, £m)	3.67	3.81
Other Benefits (35yr PV, £m)	0.00	0.00
Direct Costs (35yr PV, £m)	2.29	2.26
NPV (35yr PV, £m)	5.96	6.07
High Carbon Scenario		
Carbon Emission Savings (35yr PV, £m)	0.00	0.00
High Carbon NPV (35yr PV, £m)	5.96	6.07

9 Preferred Option Scope and Project Plan

9.1 Preferred option

The preferred option considered for the RIIO-2 period is to pre-emptively replace 165 aged telemetry units to comply with the requirements of IGEM/TD/13.

9.2 Asset Health Spend Profile

Table 6: Spend Profile

Asset Health Spend Profile (£m)					
Pre-emptively replace	2021/22	2022/23	2023/24	2024/25	2025/26
Scotland LDZ	0.90	0.85	0.84	0.91	0.98
South of England LDZ	1.02	0.95	0.96	0.96	1.06

9.3 Investment Risk Discussion

Risk Matrix

Risk Description	Impact	Likelihood	Mitigation/Controls
Resource Delivery	Delayed project delivery	<=20%	Project will be assigned to a dedicated project team who will purely concentrate on telemetry work programme delivery.
Over Spend	Additional budget	<=20%	Package of works is based on delivery tier 1 and 2 telemetry compliant systems; however some sites will be downrated to tier 3 telemetry which will result on a lower cost telemetry solution.
Unsuccessful tender	Additional budget	<=20%	This is if tender savings are not made. SGN have a streamlined delivery plan and would manage the work to make additional cost savings through project delivery.

CAPEX Sensitivity

Table 7: Sensitivity Results

	Scotland LDZ			South of England LDZ's		
	Low	Mid	High	Low	Mid	High
GD2 Capex (£m)	3.80	4.47	6.71	4.21	4.96	7.43
Number of Interventions	155	155	155	208	208	208
Carbon Savings ktCO2e (GD2)	-	-	-	-	-	-
Carbon Savings ktCO2e /yr	0	0	0	0	0	0
Carbon Emission Savings (35yr PV, £m)	0.0	0.0	0.0	0.0	0.0	0.0
Other Environmental Savings (35yr PV, £m)	0	0	0	0	0	0
Safety Benefits (35yr PV, £m)	3.7	3.7	3.7	3.8	3.8	3.8
Other Benefits (35yr PV, £m)	0.0	0.0	0.0	0.0	0.0	0.0
Direct Costs (35yr PV, £m)	2.0	2.3	3.3	2.0	2.3	3.2
NPV (35yr PV, £m)	5.7	6.0	6.9	5.8	6.1	7.0

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 replacement. 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 15% 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 50% 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 8: Capitalisation Rate Sensitivity Results - Scotland

Scenario	1	2 SC	3	4
Capex (%)	65	46	100	0
Opex (%)	65	46	0	0
Repex (%)	100	100	100	0
Output				
NPV (20yr PV, £m)	3.64	3.74	3.46	
NPV (35yr PV, £m)	5.84	5.96	5.62	
NPV (45yr PV, £m)	6.12	6.16	6.04	
Payback	0.00	0.00	0.00	0.00

Table 9: 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)	3.67	3.81	3.49	
NPV (35yr PV, £m)	5.90	6.07	5.69	
NPV (45yr PV, £m)	6.17	6.23	6.10	
Payback	0.00	0.00	0.00	1.00

Appendix A - Telemetry Types

Figure 4: SGN Telemetry Structure

Telemetry Installation Standard	Tier 1	Tier 2	Tier 3	Tier 4
Relative costs	Highest	Medium	Low	Lowest
Communications	• Resilient / duplicate communications path • Typically VSAT primary and dial backup or GPRS or ADSL secondary	• Single communications link • Typically MPT1411 or VSAT or public service network	• Single communications link • Typically GPRS other public service network	• Single communications link • Typically GPRS other public service network
Remote Telemetry Unit	Typical I/O a) Analogue Inputs ≥32 b) Digital inputs ≥48 c) Analogue outputs ≥8 d) Digital Outputs ≥8 e) Counters ≥2 Modular construction PLC functionality Conformance to BS EN 61131-3	Typical I/O a) Analogue Inputs ≥8 b) Digital inputs ≥16 c) Analogue outputs ≥2 d) Digital Outputs ≥2 e) Counters ≥1 Modular construction PLC functionality Conformance to BS EN 61131-3	Typical I/O a) Analogue Inputs ≥8 b) Digital inputs ≥16 c) Counters ≥1 Simple functionality	Typical I/O ➢ Max 4
SCADA scanning	• Real time - 1 minute scanning.	• Real time – 1 minute scanning	• Hourly/ daily/ on demand • Report by exception	• Daily/ weekly/ on demand • Report by exception
Power Supply	• UPS • 12 hour battery backup • Facility for standby generation	• UPS • 8 Hour battery backup	• Integrated or separate battery. • Power saving technology. • Solar or wind power sources.	• Long life battery either integral or separate • Power saving technology
Typical Building	• Brick or GRP room -25M²	• Brick /GRP/ metal clad for pre heating boilers - 16M²	• GRP kiosk 2M²	• GRP cabinet or none.

Table 10: Typical alarm signals monitored via telemetry

Inlet pressure	Mains supply	Critical gas supply
Outlet pressure	Battery charger status	Boiler alarm
Station Flow	Engineer-on-site	PRS setpoint alarm
Filter differential pressure	Security alarm	Actuator gas critical alarm
Slam shut indication	Emergency telephone	Controller fault alarm
Burst disc alarm	Outlet temperature	Setpoint limits
Actuator gas flow alarm		

Appendix B - PRS Radio UHF Replacement

Introduction
The existing Ultra High Frequency (UHF) MDS NR-104L radios were installed across SGN circa 1999 to support the replacement of SGN telemetry system with Ulysses telemetry. By the start of RIIO-2 price control period in 2021, these radios would have been in service for 22 years.

Reasons for Replacing these Aged Radios
The MDS NR-104L radio is now deemed mature and close to its end of life. It is approved to MPT1411 which was introduced to bring point to multipoint (P-MP) fixed systems together in a dedicated band as mixing services with different link budgets can be problematic. MPT1411 have been superseded with ETSI (European standards organisation).

On National Transmission Stations, SGN provides data to National Grid which is an integral part of the Uniform Network Code (UNC). The UNC is a legal and contractual framework which is a common set of rules for all industry players which ensure that competition can be facilitated on level terms.

SGN Maintenance operatives over the last two years have seen an increased number of failures on these radios. The limited spares available to SGN are running out quickly and there is no certainty this will suffice before the end of GD2. Generally during the summer periods, SGN is experiencing increased communication loss on radio systems due to tropospheric interference.

Failure to adequately monitor the gas network with a reliable telemetry system would not support the recommendations detailed within IGEM/TD/13 (section 10.2.1.5 and section 10.2.3) which is the recognised gas industry standard.

Achievement Goals
SGN aims to replace 188 MDS NR104L radios with a suitable replacement which can deliver reliable communication between the outstations and GCC. The new device will be easy to implement and provide all the functionality provided by the existing aged radio. In addition to this, the radios will conform to IEC-61131-3 and meet the requirements of Electromagnetic Compatibility (EMC) Directive (2014/30/EU) and Radio Equipment Directive (2014/53/EU).

Cost Breakdown

Table 11: Radio Replacement Cost

LDZ	Site Type	Unit Cost	No. Sites	Budget	Category
Scotland	PRS'	£3,000	73	£219,000	Safe and Reliable
South and South East	PRS'	£3,000	115	£345,000	Safe and Reliable

Appendix C - Hilltop Site Upgrades

Introduction

SGN within the RIIO-2 control period aims to upgrade 10 hilltop base stations which receives Ultra High Frequency (UHF) signals from the outstations (gas sites) and transmit the collected data via satellite to Gas Control Centre (GCC). These communication systems have been in use circa 1970s.

The communication links between the outstations and the base station is currently being managed by a third-party company.

Background

UHF signals are sent via a radio (remote radio) to another radio (master radio) which is installed at the base station. The master radios, and all the remote radios, form a continuous network over which data to and from the telemetry system is transmitted. The radio system also includes a Network Management System, which gives a centralised view of how the radio system is operating and allows its operators to identify whether an individual radio unit is working correctly.

Project Justification

The hilltop sites are critical to the communication strategy of remote sites utilising UHF technology. Owing to the age of these assets and the criticality of the function the hilltop provides, SGN will be looking at upgrading electrical equipment and carry out some minor works to ensure the health and safety of people, assets, and the environment is well protected.

Cost Breakdown

Table 12: Cost breakdown for Hilltop Sites

LDZ	Site Type	Unit Cost	No. Sites	Budget	Category
Scotland	Hilltops	£35,000	1	£35,000	Safe and Reliable
South and South East	Hilltops	£20,000	8	£160,000	Safe and Reliable
South and South East	Hilltops	£35,000	1	£35,000	Safe and Reliable

Appendix D - Cost Breakdown

The cost shown below are based on previous project works within the GD1 RIIO price control period.

PRS Cost are as follows:

Table 13: Cost for RTU replacement on a PRS

	Baseline (Ad-Hoc)		Option_1 (Proactive Replacement	
	Offtake	PRS	Offtake	PRS
Design	19,400	19,400	9,400	9,400
Project Management	17,082	17,082	17,082	17,082
Materials/Installation/Commissioning	19,806	19,806	9806	13,500
Offtake Uplift	14,000		14,000	
Total	70,288	56,288	50,288	39,982

For Offtakes there is an additional £14k spend for additional panels and software programming. This was based on the GD1 Southern Offtake projects.

For detailed costs, please see attached spreadsheet.

Summary of Costs (per unit)

Site Type	Ad Hoc Cost (Baseline)	Reference	Packaged (Option 1)	Reference
Offtake	£70,000	Quotation from Major Construction	£50,000	Estimate. Based on significant reduction on design, material and installation costs as well as a reduction of project management costs.
PRS	£56,000		£40,000	

Appendix E - Acronyms

Table 14: Table of Acronyms

Acronym	Description
DMR	Dual Modular Redundancy
GCC	Gas Control Centre
GTMS	Gas Transportation Management System
HSE	Health and Safety Executive
IN	Integrated Network
LDZ	Local Distribution Zone
MTTF	Mean Time to Failure. MTTF is the ratio of the total time to number of units under test

Table 15: Applicable Standards

Standards	Description
IGEM/TD/13	Pressure regulating installations for Natural Gas, Liquefied Petroleum Gas, and Liquefied Petroleum Gas/Air Edition 2
IGEM/SR/15	Integrity of safety-related systems in the gas industry Ed. 15 with amendments December 2015 communication 1784
IEC 61131-3	Programable Controllers
IEC 62443	Security for industrial automation and control systems. Security programme requirements for IACS service providers