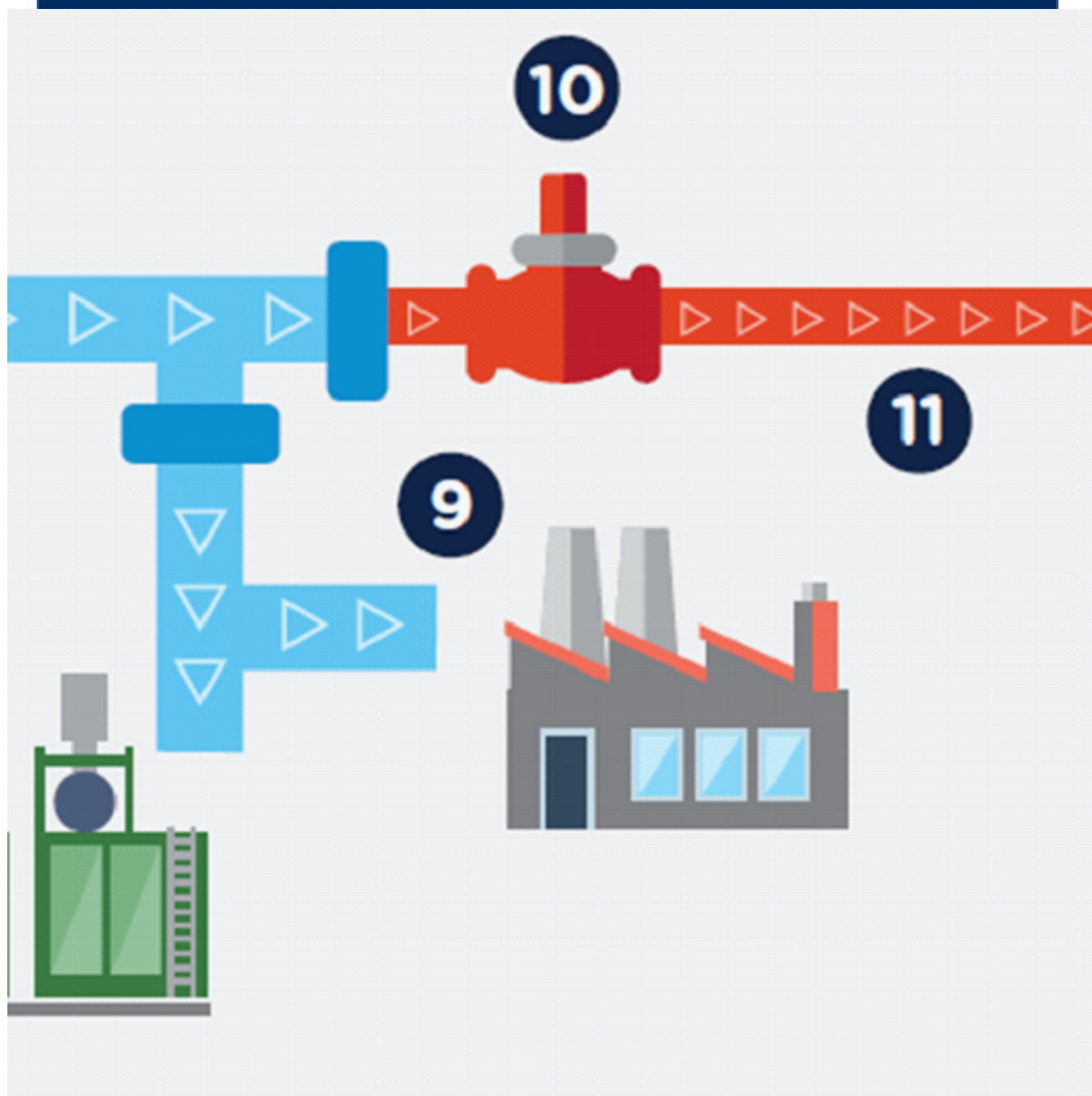


RIIO GD2 Business Plan Appendix

Distribution Integrity and Governors December 2019



Complete network diagram with explanations at Chapter 13



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1 Overview

Scope of this appendix

Network integrity is about ensuring the fixed assets that make up our networks remain fit for purpose; safe and secure with the capability of transporting an adequate supply of gas directly to our customers. This Distribution Integrity and Governor Plan details the capital expenditure necessary in GD2 to improve the condition and reliability of our assets to ensure they operate safely, efficiently and reliably.

This appendix sets out our capital investment plan for the integrity related investment on the distribution network (below 7 bar). This includes the pipes themselves, the governors that manage the pressure, the valves that control the flow and the equipment that helps us protect the network. These comprise of both 'above ground' and 'below ground' assets.

Proposed interventions on above and below ground governor installations include full replacements of governors with high probability and consequence of failure as well as other refurbishment activities to extend the life of the assets. The proposals include a combination of site specific named projects and programmes of work which will include items such as the management of cathodic protection (CP) systems to prevent corrosion occurring on steel pipelines and extend the asset life, network valve remediation to ensure that strategic valves are available to operate as and when required either in emergency situations or during the course of operating the network and the installation of marker posts on Intermediate Pressure (IP) pipelines which will indicate the location of the pipelines to anyone intending to carry out work in the vicinity, and therefore reduce or eliminate 3rd party damage. These are just some examples of a wide variety of integrity related work proposed. These proposals are set out in detail throughout this appendix and in section 10, the 'Named Project' annex.

This appendix is in addition to, but separate from, the Transmission Integrity and Compliance appendix (021), which proposes a similar investment plan for the network which operates at pressures greater than 7bar, and the Asset Maintenance appendix (016) which sets out how we inspect, maintain and repair the network until the asset requires to be replaced on reaching the end of its safe design life. Any growth, reinforcement work or investment to improve the resilience of the network is set out in the Capacity Management appendix (018).

The Distribution Integrity plan will be closely aligned to the Asset Maintenance appendix (018) which predominantly focuses on the delivery of activities such as CP and governor maintenance. In the case of other appendices, the connection may be less obvious, but in the case of certain works we are planning, such as Kings Ferry Bridge crossing to the Isle of Sheppey in Kent, this will also affect the resilience and capacity of the network. Understanding these linkages are important to ensure we gain maximum opportunity for synergy and cost efficiencies where possible.

Impact

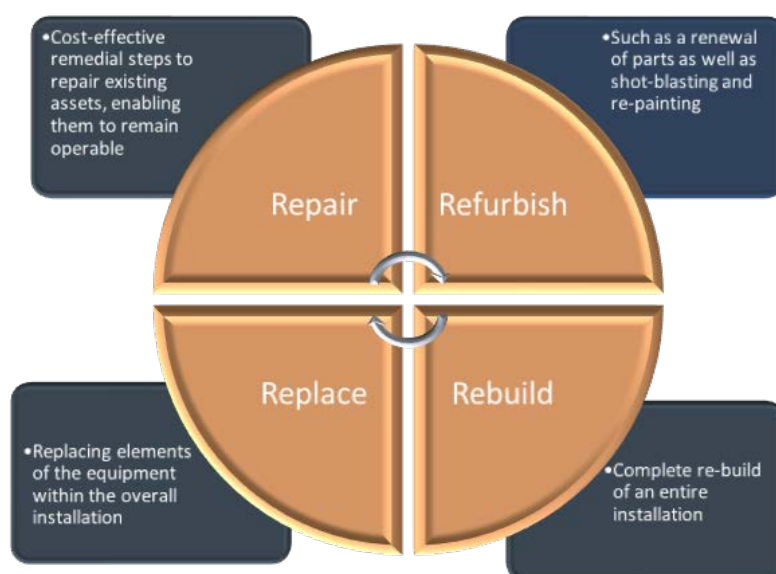
The gas which we transport is a potentially dangerous substance, but whilst it is retained within the pipe it is safe. If it escapes and ignites then there is a risk to human life and property. Under our Licence, we operate to a Safety Case that is approved by the Health and Safety Executive (HSE), to ensure we manage and maintain a safe and secure network. To deliver this, we need a continued investment programme to ensure that the assets are fit for purpose and in a safe operational condition. Our customers and stakeholders have told us that maintaining current levels of safety is very important to them, that reliability is important to them and that maintaining a safe and reliable network should be our priority for GD2. This customer expectation is supported by a strong legislative and regulatory framework that provides clear focus on when we should act, and these are supported by internal procedures that set out how we should act.

Approach to GD2

Our approach to GD2 is to deliver the core ‘here and now’ requirements of safety and resilience but taking due consideration of the decision that the Department for Business, Energy and Industrial Strategy (BEIS) will take regarding the long-term future of the Gas Networks during GD2 and the decarbonisation work of the Gas Distribution Network companies.

Through-out GD1 we have maintained a 4Rs strategy of Repair, Refurbish, Replacement and Rebuild, focusing on asset repair where possible and then moving to more intrusive interventions where necessary.

Figure 1: Our 4Rs strategy



Forecast Investment – GD1 Expenditure and Proposed GD2 allowances

Table 1: SGN forecast investment (18/19 Prices)

SGN (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.91	0.75	0.00	0.00	0.00
Protection									1.71	1.63	1.62	1.62	1.62
Data Loggers									1.16	1.11	1.10	1.10	1.11
Valves									1.11	1.06	1.05	1.05	1.06
Environmental									1.89	1.78	1.02	1.02	1.03
Governors									11.46	11.37	11.53	11.53	11.59
Governors & Integrity GD1	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44					
Total	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44	18.25	17.70	16.33	16.32	16.41

Table 2: Scotland forecast investment (18/19 Prices)

Scotland (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.11	0.00	0.00	0.00	0.00
Protection									0.49	0.49	0.49	0.49	0.49
Data Loggers									0.43	0.43	0.43	0.42	0.43
Valves									0.43	0.43	0.43	0.43	0.43
Environmental									0.26	0.26	0.26	0.26	0.26
Governors									2.69	2.69	2.88	2.89	2.94
Governors & Integrity GD1	3.42	9.49	3.20	2.52	2.62	2.90	3.36	3.77					
Total	3.42	9.51	3.20	2.53	2.63	2.94	3.34	3.77	4.41	4.31	4.48	4.49	4.55

Table 3: Southern forecast investment (18/19 Prices)

Southern (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.80	0.75	0.00	0.00	0.00
Protection									1.22	1.14	1.13	1.13	1.13
Data Loggers									0.73	0.68	0.67	0.67	0.68
Valves									0.67	0.63	0.62	0.62	0.62
Environmental									1.63	1.52	0.76	0.76	0.77
Governors									8.77	8.67	8.65	8.64	8.65
Governors & Integrity GD1	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66					
Total	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66	13.83	13.39	11.84	11.82	11.85

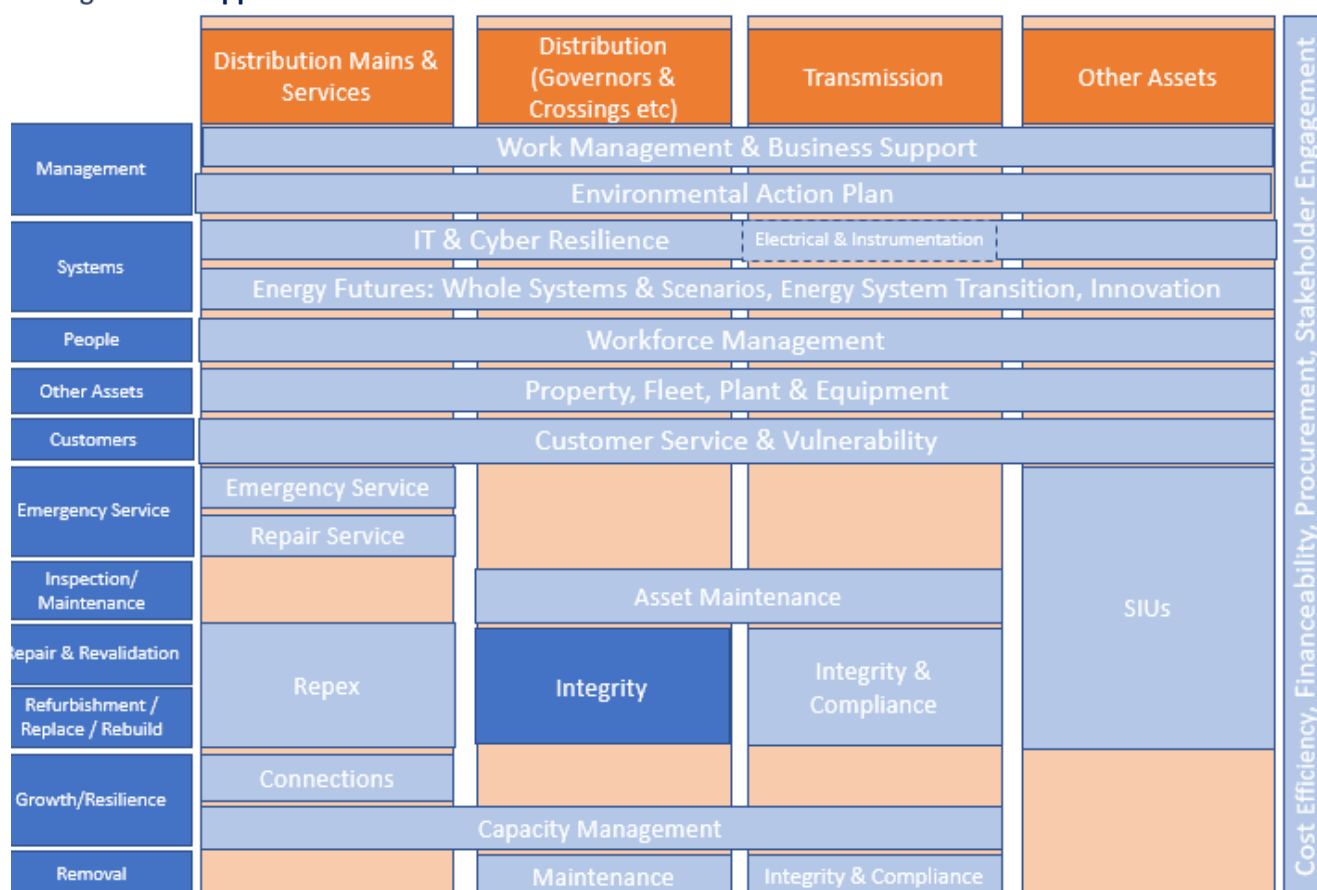
2 Distribution Network Integrity within the Business Plan

This Distribution Integrity & Governors appendix outlines the proposed programme of works required to ensure that the integrity of the distribution network and associated plant, such as governors, is maintained at the level necessary to ensure the system continues to operate safely, efficiently and reliably.

Given the transferable nature of the skill set across the distribution network, and the volume of work involved, the repair work that sustains network integrity is separated out from the inspection and maintenance work. Repair work that is in direct response to a public reported escape (PRE), is not considered as capital integrity investment and is operating expenditure as defined in the Emergency Service appendix (013) and Repair Service appendix (014).

This appendix sets out our experience in GD1, along with some of the key legislation upon which our internal procedures are based, which in turn determine the level of investment we are proposing to make in GD2. Over the course of GD2 we expect expenditure on distribution integrity to be less than 4% of total expenditure.

Figure 2: Appendix Structure



Network Integrity is defined as the capital investment in operational fixed assets in response to a deterioration in condition, performance or operability below that which is considered to be acceptable. This is determined using Cost benefit analysis (CBA) models, and derived from the asset condition, inspection and remediation results, faults, telemetry alarms, CM/4 inspections (condition and compliance monitoring) and with deterioration in C55 (our Asset Investment Management Tool). Where we are managing network assets, our work activities can be categorised as:

- **Inspection** - Our primary means of confirming the continued operability of assets is through survey and functional testing, both of which are deemed forms of inspection of assets, where no intrusive activities are undertaken. In some specific cases, particularly involving complex plant such as distribution governors, SGN

undertakes more detailed diagnostic inspection, where the operation of plant is subject to detailed measurement and analysis by computer algorithms. Inspection activities are undertaken in accordance with work orders generated automatically to a planned frequency and with the aid of work instructions;

- **Maintenance** - In some isolated cases, we undertake planned maintenance including lubrication, overhaul and cleaning of assets. Maintenance activities are also undertaken in accordance with work orders and instructions;
 - **Repair** - On occasion, the inspection regime identifies assets that do not perform to the required specifications. Then, the individual asset may be repaired to return it to satisfactory service. A repair activity does not constitute refurbishment as it does not impact either the overall health (reliability, condition) of the system or future deterioration of that system. Inspection, maintenance and repair are activities covered by the Asset Maintenance appendix (016);
 - **Revalidation** - Some specific activities, such as detailed inspection using non-destructive techniques and hydrostatic testing, are required at regular intervals in order to ensure the asset is fit for continued operation. Many of these activities are encompassed within the Pressure Systems Safety Regulations 2000 and are detailed within the Written Schemes of Examination. Failure to undertake these revalidation activities will render the asset as unfit for operation. We use the term 'Compliance' to denote work to maintain key records, drawings, safety plans and other minimum requirements of legislation;
 - **Refurbishment** - The current health, including reliability and condition, of an asset or its future deterioration can be improved by an effective painting programme, encapsulation of defects, systematic and comprehensive overhauls etc. The health of the asset would not be returned to an 'as new' condition, but rather a condition that would allow an asset to provide an extended service;
 - **Component replacement and rebuild** - Replacement of individual components or the whole system remain key interventions to guard against 'end of life' failure that could incur catastrophic consequences. Refurbishment, component replacement and rebuilds are activities that impact the condition and reliability of assets and their immediate rate of deterioration;
 - **Growth** - New assets are often required to provide additional capacity to allow existing customers to take more gas or to supply new customers. Where only the additional capacity is supplied by the new asset, then the consequences of failure of existing assets remains stable. However, the new assets can reduce demand on existing assets and, in this case, the consequences of failure of existing assets can be reduced accordingly. Growth related projects are also detailed within Capacity Management appendix (018);
- Resilience** - Occasionally, the security of supply to individual customers or groups of customers can be deemed inadequate and additional assets may be installed to improve that security of supply. Resilience is therefore deemed a separate intervention as the primary aim of such an intervention is to reduce the consequence of failure of existing assets; and
- **Removal** - Occasionally, assets may no longer be required or may become redundant as a result of other replacement interventions elsewhere or legacy assets that are still in situ. With changing gas demands and efficiency improvements and the drive to respond to climate change, removal is therefore an active and increasing mode of intervention.

In order to support our investment proposal, Engineering Justification Papers (EJPs) have been developed which set out the options considered and the cost benefit of the options. Please refer to section 6.5 of this appendix for a list of the EJPs generated.

3 GD1 Performance & Learnings

3.1 Overview of Services Delivered

Our investment programme for GD1 was developed to sustain a safe and reliable network. We manage the network that distributes natural and green gas to homes and businesses across Scotland and southern Networks. We deliver a safe, secure and reliable gas supply to 5.9 million customers and we operate within a regulatory environment under a licence issued by Ofgem.

For GD1 we requested £73.4m for Governor related projects in Southern and £36.8m in Scotland (2009/10 cost base). The Authority made reductions of £34.7m in Southern and £22.3m in Scotland providing and allowance of £38.7m in Southern and £14.5m in Scotland.

During GD1 we have had an ongoing programme of governor replacement and refurbishment in order to maintain security of supplies, targeting governors with poor asset health and high criticality. We have, in Scotland, replaced 27 governors on average each year and expect to complete 214 over the course of GD1. While, in Southern we have replaced 70 governors on average each year and expect to complete 558 over the course of GD1 which is aligned to the numbers set out in the GD1 Final Proposals. We have also completed a large number of above ground governor housing replacements and a small proportion of the replacement of Elkington gatic covers for below ground governors where there is a risk to security of the governor, but also a manual handling challenge. This will continue into GD2 as detailed later in this appendix.

During GD1 we have also implemented a detailed condition assessment for governors which will support the identification of governors requiring refurbishment or replacement throughout GD2 and beyond. Some of the findings from these assessments are detailed later in this appendix.

We have also been carrying out a variety of other distribution integrity projects and programmes of work, with one of the most significant being fitting access prevention measures to pipe crossings that may be exposed across a road, river or railway and often attached to bridges. These measures are essential in order to protect members of the public from injury but also to prevent any third party damage to the pipelines.

A further significant programme of works has involved the installation of vehicle protection measures at a number of above ground governor sites, to mitigate against the risk of third party damage from vehicles. This followed a review considering which installations may face a greater risk of such an incident i.e. in most cases where the governor was situated close to a road, near a bend and where a number of other criteria were met.

We have also continued to maintain and replace cathodic protection systems which prevent corrosion on steel pipelines, to carry out remediation of strategic valves within our distribution networks and to ensure continued commitment to the installation and replacement of marker posts on our IP pipelines to prevent third party damage. These programmes will all continue into GD2 and are detailed later in this appendix.

3.2 Legislative Background

There are four key pieces of legislation that drive the maintenance and investment in the gas distribution system operating at pressures up to 7barg. These are: Pressure Systems Safety Regulations 2000 (PSSR); Pipeline Safety Regulations 1996 (PSR); Gas Safety Management Regulations 1996 (GSMR); and the Health and Safety at Work Act 1974 (HSWA). Other regulation includes Electricity, Safety, Quality and Continuity Regulations 2002 (ESQCR) and the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).

Pressure Systems Safety Regulations 2000 (PSSR)

The PSSR covers the safe design and operation of pressure systems to reduce the risk of failure of a pressure system or one of its components that could give rise to a major hazard. PSSR requires that operators document and adhere to a Written Scheme of Examination (WSoE) for all pressure systems, including safety devices and key vessels, in conjunction with an appointed Competent Person. We meet this requirement through our Management Procedure, SGN/PM/PS/3. Any postponements of examinations under the WSoE must be notified in writing to the Safety Authority, the Health and Safety Executive.

Pipeline Safety Regulations 1996 (PSR)

The PSR provides an integrated, goal-setting risk-based approach to the management of pipelines. The regulations cover design, construction, operation, maintenance and decommissioning activities. Regulation 13 includes the absolute requirement to ensure our distribution network is maintained in an efficient state, in efficient working order and in good repair. We demonstrate 'best practice' through the adherence to industry recommendations, including those of the Institution of Gas Engineers and Managers (IGEM). The following recommendations and guidance provide the core structure for our operations:

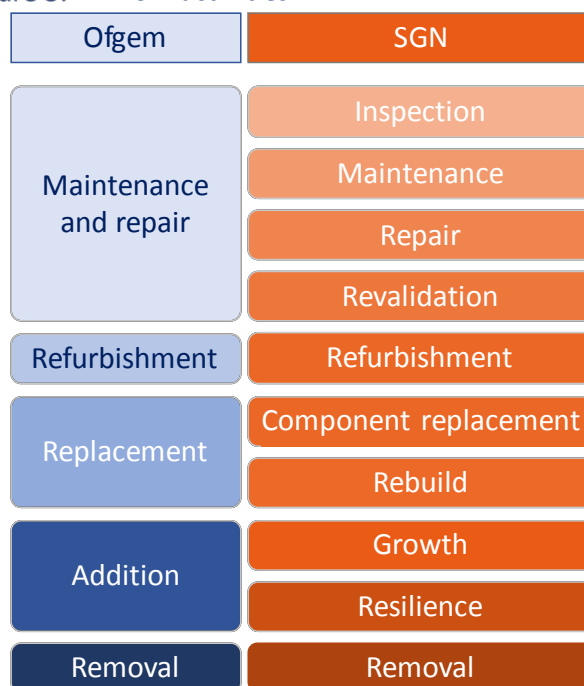
- IGEM/TD/3 - Steel and PE pipelines for gas distribution,
- IGEM/TD/13 – Pressure Regulating Installations for Natural Gas, Liquefied Petroleum Gas and Liquefied Petroleum Gas / Air
- IGEM/SR/25 – Hazardous Area Classification of Natural Gas Installations.

These recommendations are implemented through our safety management system, via a number of management procedures, work instructions and specifications. These have been developed to ensure compliance and confirm continued fitness for purpose whilst incorporating best practice.

Gas Safety Management Regulations 1996 (GSMR)

The GSMR covers the safe management of gas flow through our network, particularly those parts supplying domestic consumers. It includes a duty to minimise the risk of a gas supply emergency. Gas transporters are required to prepare a Safety Case which must be submitted to HSE for acceptance. The safety case should describe how the network is operated and maintained with references to industry standards (e.g. IGEM

Figure 3: Work activities



Standards) and written procedures where applicable. Our safety case has been prepared for Scotland Gas Network plc and Southern Gas Networks plc (as licensed to convey gas in GB and in accordance with the requirements prescribed in GSMR) and accepted by the HSE. Once accepted by the HSE, regulation requires the duty holder to comply with their accepted safety case.

Health and Safety at Work Act etc 1974 (HSWA)

The HSWA lays down wide-ranging duties on employers. For example, employers must protect the 'health, safety and welfare' at work of all their employees as well as others on their premises, including visitors and the general public. Other general duties include the provision and maintenance of plant and systems of work that are, so far as is reasonably practicable, safe and without risks to health in connection with the use, handling, storage and transport of articles and substances. We demonstrate 'best practice' through the adherence to industry standards and our safety management system.

Electricity, Safety, Quality and Continuity Regulations 2002 (ESQCR)

The ESQCR define the minimum separation distances from independent earthed structures. These require at least 3 metres separation with higher voltage pylons and power systems, and a minimum separation of 0.8 metres for lower voltages. We meet this requirement through our Specification Procedure, SGN/SP/EL/13.

Dangerous Substances and Explosive Atmospheres Regulations (DSEAR)

The DSEAR cover the control of risks to safety from fire and explosions. The regulation includes flammable gas as a dangerous substance and we demonstrate compliance through the adherence to industry practice e.g. IGEM/SR/25.

Inspection/Work Programmes

In addition to the above, we have recently implemented a formal condition assessment programme, SGN/PM/CM/4 part 2 (CM/4), with the aim of ensuring that we carry out consistent, periodic assessments of all assets on below 7 bar installations, to ensure continued fitness for purpose of those assets. Any defects identified are fully assessed and quantified, prior to the remediation of any critical defects. The CM/4 inspection builds on various condition surveys including VS/02 (Industry Standard for Visual Inspection) and painting surveys already undertaken to support the prioritisation of risk-based inspection. The process is aimed at ensuring a detailed level of knowledge is obtained and recorded for all sites to identify any defects for prioritisation in a remediation plan.

The CM/4 process feeds into our ongoing programme of governor replacement work that was originally identified and implemented by British Gas in 1980. Our risk scored, prioritised replacement programme known in the industry as "R6 Governor Replacement Programme" is managed through our Management Procedure SGN/PM/GOV/1. The R6 Governor Replacement Programme is a direct result of improved knowledge of maintenance, reliability, fault failure data and improved technology. The programme supports prioritising the replacement of assets that are identified as obsolete and/or in a poor mechanical condition or have reached the end of their safe mechanical design life.

Other key inspections/work programmes include:

- The condition and risk associated with exposed pipes is managed in accordance with our management procedures SGN/PM/MAINT/14 and SGN/PM/MAINT/15. These procedures allow us to comply with PSR and IGEM industry standards;
- Cathodic Protection (CP) systems and corrosion protection are set out in IGEM/TD/3, which is the industry design standard we use for low, medium and intermediate pressure pipelines up to 7bar. This standard requires that a combination of CP and properly applied coating systems is used to provide corrosion protection to buried steel gas pipelines and fittings; and

- PSR requires pipeline operators to take steps to inform persons of the presence of buried pipes. The requirements for appropriate markings are set out in IGEM/TD/3 which carries a specific requirement for any pipe operating >2barg, that is not located in the highway, to be indicated at suitable intervals.

3.3 GD1 Output and Delivery

As explained in our Transmission Integrity and Compliance appendix (021), during GD1 the GDNs introduced Network Output Measures (NOMs) at the request of Ofgem for 8 different categories of assets. These included Distribution mains, services, risers and Governors. Three of these asset groups are part of our Repex appendix (019) and the fourth (Governors) are within this paper.

Recent work with Ofgem has seen NOMs being replaced with Network Asset Risk Measures (NARMs). The table below sets out the monetised risk at the start of GD1 and the delta to be achieved by the end of GD1.

Table 4: Governors monetised risk

Governors	2013	2021 without intervention	2021 with intervention	Delta (change in risk)
Southern Network	£8.590m	£9.696m	£9.552m	£0.144m
Scotland Network	£3.050m	£3.230m	£3.158m	£0.072m

We are on track to deliver the specified workloads targeted for governors, and the change in risk shown in table 4 contributes to the GD1 output for our monetised risk reduction. In GD1 there were no defined outputs for distribution integrity. In considering what one might have done differently during that period, this is an area we have identified where a change of approach may be appropriate for GD2. While most of the work on governors will continue to have a NARMs output, the other areas not covered by NARMs are specified as a price control deliverable.

3.4 GD1 Customers Experience

When reviewing our GD1 experience we have considered the range of activities carried out and evaluated against a number of categories, each of which have ultimately resulted in improving the quality of service provided to our customers primarily ensuring their security of supply. The results of this review are summarised below in Table 5 and show the range of categories each initiative has had a positive impact upon. This work has also informed our investment proposals for GD2.

During GD1 we have continued to invest in on-going programmes of works for Loggers, Cathodic Protection Schemes, IP Marker Posts, Valves and other integrity issues such as Nitrogen Sleeves, Tunnels and Coastal Erosion. These are key integrity areas which enable us to ensure we maintain a safe and reliable network. 'Maintaining a safe and reliable network' means investing to ensure the system is safe, dependable and will provide system security meaning customers see less supply interruption and less disruptive unplanned works. Such an approach also reduces the number of public reported gas escapes on our network, meaning it is safer, with less risk to members of the public and our employees. Without these initiatives, it would not be possible to maintain the high levels of service we provide to the customer. It's similar with our investment in loggers and pressure management where that investment allows us to minimise our impact on the environment and ensure the planning tools we use to inform future investment strategies are as accurate as possible at all times, mitigating the risk on inappropriate investment and the business incurring unnecessary costs. All these elements, while at times go unseen, ultimately influence operating costs which in turn influence customer costs.

Adopting this approach is also consistent with feedback we have received from our stakeholders. We have looked to focus investment in areas which customers have indicated they see as a priority, focussing on safety, we have kept the gas flowing and kept the costs down. Moving forward, customer engagement and ensuring a

positive customer experience has been a very important area in further developing our plans for GD2.

Looking back, a key lesson taken from GD1 was that customers had perhaps not been fully engaged in the development of our proposals and had the opportunity to influence. Taking the learning from that, a key priority for us moving into GD2 was to involve customers to help shape those proposals.

As such, in looking to invest in our assets to maintain security of supplies, we've also looked to enhance our knowledge of those assets, investing in systems and inspection regimes to ensure we are making the optimum investment decisions and provide best value for money to our customers. These include our CM/4 condition monitoring programmes, which provides detailed information on our governor assets, and our C55 Asset Investment Management tool which models the assets in a manner which reflects the risk associated at an individual or cohort level, and the benefits of carrying out interventions on these assets.

Improving Service Provision

As we look to form our plans and develop our strategy for the next price control GD2, we have engaged with a wide range of our customers and stakeholders to better understand what their needs are and what they expect from us. We know from this engagement, that affordability and security of supply are two of the things which they value most and this knowledge has been used to inform our business plan for 2021–26. Our independent Customer Engagement Group (CEG) is also there to look at our plans and feedback important challenges to our decisions as well as being a valuable sounding-board as we integrate our customers' views into business decisions.

Customer engagement allows us to listen to and understand what our customers want and which of our services they value the most. More interaction through social media has allowed us to become smarter in how we engage with our customers, but other and sometimes more traditional methods of engagement are equally important. We then need to use our skills to understand and translate the insight we gain into providing better services for our customers. One area our engagement suggests needs particular focus is looking after our most vulnerable customers. In this respect, it's very important we continue to focus on connecting fuel poor customers to our network both in this price control and going forward into the next. Our efforts here can make a real difference to the most vulnerable in our society.

Feedback from Stakeholders including customers has provided the following priorities:

- Acting safely
- Keeping the gas flowing
- Keeping costs down.

The work undertaken in GD1 addresses these priorities as does the work proposed for GD2.

Table 5 below summarises the impact of our work in both GD periods in terms of the above priorities and our 3 overall customer commitments as details on our business plan:

- Safe and efficient
- Shared future
- Positive impact

Table 5: Improving service provision in GD1/2

Improving Service Provision Sections	Safe and Efficient			Positive Impact		Shared Future	
	Acting Safely			Keeping the Gas Flowing		Keeping the Costs Down	
	Improved Safety	Reduced risk of injury to life	Reduced likelihood of Interference damage by third parties	Improved Integrity of Supply	Reduced risk of supply interruptions	Extended Asset Life	Improved network efficiency & reduced carbon footprint
Crossings	✓	✓	✓	✓	✓	✓	✓
Network Valves	✓		✓	✓	✓	✓	✓
Below Ground Governor Security	✓	✓	✓	✓		✓	
Cathodic Protection	✓		✓	✓		✓	✓
IP Marker Posts	✓	✓	✓	✓	✓	✓	✓
Gas Profiler & Logger Systems	✓			✓			✓
Model Validation Loggers	✓			✓			✓
Nitrogen Sleeves	✓		✓	✓	✓	✓	
Asbestos Management	✓	✓				✓	
Tunnels	✓	✓		✓	✓	✓	
Coastal Erosion	✓		✓	✓	✓	✓	
Network Maintenance Pressure Loggers	✓			✓	✓		✓
Remote Pressure Management London LP Networks	✓			✓	✓		✓
Remote Pressure Management Southern LP Networks	✓			✓	✓		✓
Governors	✓	✓		✓	✓	✓	✓

3.5 GD1 Allowances and Expenditures

To operate a safe and secure gas distribution network and deliver security of supplies to our 5.9m customers, SGN are required to continue its ongoing programme of investment in its distribution assets in GD2. This targeted investment by SGN shall ensure continued compliance with both Government Regulations and Gas Industry Standards. By law SGN are required to manage and maintain our aging and non-compliant assets that are nearing the end of their natural design life, before they fail and present the public with an unacceptable risk to their safety from an over or under pressurised distribution gas mains systems. The consequences of which could include a loss of supply to the customer or a risk of serious injuries and property damage. Table 6 below reflects the level of allowances versus actual expenditure for GD1 from 2013/14 to 2018/19 and a forecast for the last 2 years of GD1, 8-year period at both an SGN and network level.

Table 6: GD1 Allowances and Expenditure

SGN (£ms)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	8.4	9.4	10.9	11.6	13.3	14.9	12.7	12.6	93.8
Expenditure	9.0	20.3	11.1	9.1	11.2	15.4	14.1	13.4	103.7
Variance	-0.6	-10.9	-0.2	2.5	2.1	-0.5	-1.4	-0.8	-9.9

Scotland (£ms)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	2.9	3	3.4	3.4	3.8	4.3	3.5	3.5	27.8
Expenditure	3.4	9.5	3.2	2.5	2.6	2.9	3.4	3.8	31.3
Variance	-0.5	-6.5	0.2	0.9	1.2	1.4	0.1	-0.3	-3.5

Southern (£ms)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	5.5	6.4	7.5	8.2	9.4	10.5	9.2	9.1	65.8
Expenditure	5.6	10.8	7.9	6.6	8.6	12.5	10.8	9.7	72.5
Variance	-0.1	-4.4	-0.4	1.6	0.8	-2.0	-1.6	-0.6	-6.7

Includes governors and below 7 bar asset integrity

For governor related activities the programme of work was accelerated during 13/14 and 14/15 due to a slow start in other areas of the business with more complex and major construction projects involving a longer lead time for planning. This meant that targets were exceeded within those years and expenditure was higher. In 17/18 and 18/19 the expenditure decreased as using our asset health profiles as the basis for selection of governor interventions this identified units that were smaller in physical size and therefore less costly to replace. In our southern network during 16/17 and 17/18, we experienced contractual issues with one of the period contractors withdrawing their governor construction teams. Due to European procurement regulation it took over a year to appoint a new period contractor. Both networks are on target to deliver GD1 governor totals for the financial year end of 20/21.

Distribution integrity works tend to fluctuate year on year as we are often dealing with emerging issues that may not have been identified at the outset - the workload and associated costs would not have been known at that time, but because of circumstances or an event, sometimes outside of our control, such activities must be delivered. Examples might include expenditure associated with coastal erosion which at that time was probably not widely considered as a major risk, but for which, as a result of our GD1 experience, an allowance is now detailed within our proposals for GD2. Similarly, the requirement to install access prevention measures for exposed pipelines and vehicle protection measures were not considered when developing our GD1 proposals, but in the course of the period a requirement arose to develop work programmes for each.

3.6 GD1 Lessons Learnt

This section aims to highlight the key challenges and lessons learnt from GD1, and how these have informed our strategy for GD2.

Previously within section 3.3 it was highlighted that there were no defined outputs for distribution integrity elements defined for GD1. This was clearly an issue and as a result we have set clearly defined outputs for our GD2 proposals as documented in section 6.2 of this appendix. In section 3.4 we outlined that leading up to, and during the early stages of GD1, we did not place sufficient focus on customer engagement. This is considered a major shortcoming and in the latter part of GD1 and in the lead up to GD2 a completely different approach has been adopted. Specific detail on our stakeholder engagement is detailed in section 4 of this appendix and in section 7 the Stakeholder Annex.

In section 3.5 when discussing allowances and expenditures, it was highlighted that with distribution integrity we are often dealing with emerging and previously unidentified issues. While this may continue to be the case in the future, critically the learning gained also informs our thinking into the future and ensures similar requirements are part of our proposals for GD2. Highlights of some of those key areas are detailed below.

It is important to recognise the impact of such works on consumers bills. While a number of these emerging areas may appear to be additional expenditure, often the investment in question is driving savings in other areas, reducing opex, reducing the risk of incidents and the associated management costs. At all times the investments we have made will have been considered as the optimum, most efficient investments for the wellbeing of the assets and the safety of members of the public and employees. Similarly, in some of the more established areas of expenditure, such as our governor replacement programme, throughout GD1 we continually looked to innovate and to improve our planning processes, adopting a holistic, integrated view across a range of processes seeking to drive efficiencies and savings – at all times, mindful of the ultimate impact on customer bills. We believe we delivered on those objectives during GD1.

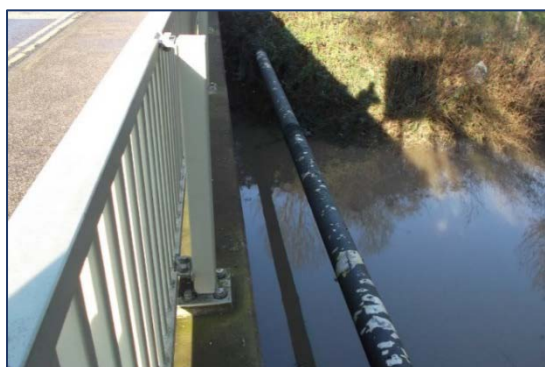
The learnings in these areas have helped shape our proposals for GD2 and how best to deal with emerging issues or prepare for future uncertainties moving forward.

Crossings

A crossing is considered any part of the network that crosses an open-air space, typically to cross over road, river or railway. These pipes are typically attached to bridges and as they are usually external, they are exposed to the elements, placing them at risk of an elevated rate of corrosion and deterioration than a buried pipe. Given their exposed position, there is a greater risk of third-party interference and members of the public may try to climb onto them.

During GD1 the need to install access prevention measures to protect both the crossing and members of the public was identified and as such has seen a substantial programme of work to complete this during GD1. As part of our comprehensive survey and risk assessment we continue to assess the condition of the pipework to identify any further deterioration or risk. This has informed some of our projects of work proposed for GD2.

Figure 4: Before intervention



After intervention

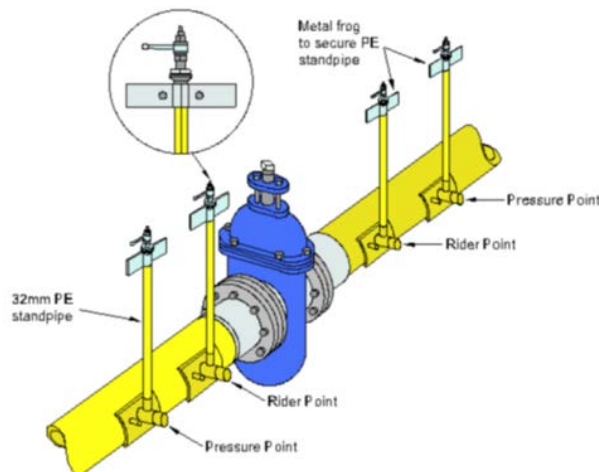


Network Valves

Valves are a key component of the network infrastructure and facilitate the rapid control of any situation in any part of the network. They minimise the potential loss of gas and improve the overall security of the network during system failure. They also facilitate maintenance, repair, modification, testing and commissioning.

During GD1 having undertaken a programme of surveys on our most strategic and critical valves, we have identified that often they are not installed to the current required standard. This has led to a programme of valve remediation during GD1 to ensure that the valves are accessible and operable as and when required. This programme of work will continue on into GD2.

Figure 5: Valve Diagram



IP Marker Posts

The Pipeline Safety Regulations require pipeline operators to take steps to inform persons of the presence of buried pipes. However, all buried utilities are susceptible to unintended damage by third parties carrying out works nearby. SGN provide scale maps of all infrastructure on request to any third party wishing to work near our assets. Providing maps of infrastructure is a reactive response on our part to protect assets and those working or living nearby.

Another fundamental element of damage prevention is installing and maintaining pipeline marker posts. These marker posts indicate the presence of the pipe, the route of the pipe and act as a permanent reminder to anyone in the area that there is a pipe operating at pressure buried in the area. As set out in IGEM TD/3, this carries a specific requirement for any pipe operating >2barg, not located in the highway, to be indicated at suitable intervals (rail, road and river crossings, field boundaries and where practicable at changes in direction in open ground).

Figure 6: Marker Posts



Marker posts are a common feature on all buried utilities, the intention being to highlight the presence of the buried service. The post will also carry basic information regarding the product being carried, the depth of cover and details of the owner/operator. Most operators will have a marker post regime consistent with that identified in TD/3, irrespective of the product being transported.

During GD1 we have identified that many of the existing concrete marker posts are becoming ineffective and are increasingly deteriorating, becoming more susceptible to damage (including vandalism) and posts installed at field boundaries and verges can become obscured by vegetation if not regularly maintained.

We have recently completed remediating 100 IP marker Posts in Southern at a cost of £35,000 and 50 in Scotland at a cost of £16,250. This work is intended to increase over the remaining period of this price control in both networks.

The new M4 type marker posts are made of tough, lightweight high density polyethylene (HDPE). It is made from 100% post-consumer recycled plastic, that needs no repainting or maintenance. Designed for maximum strength it prevents damage and the push-in faceplates deters tampering and vandalism. The M4 post is within manual handling guidelines allowing for single worker installation.

We are planning to continue this programme into GD2 to highlight the position of the pipelines and minimise third party damages.

Nitrogen Sleeves

Nitrogen sleeves have historically been installed to provide additional protection for pipelines that cross traffic routes (including roads, railways and water courses) or traverse areas with high population densities. Surveys of these assets are carried out on an annual basis to maintain and monitor the pressure of nitrogen within the sleeve to ensure it remains sound. In total 21 nitrogen sleeves are currently commissioned in our southern Network.

In GD1 we have been undertaking a programme to inspect and maintain the sleeves and have identified 5 failures which have resulted in the removal of the nitrogen and installation of grout. This solution has been instigated only after first re-pressurising the sleeve with nitrogen, monitoring and confirming the integrity has been permanently weakened.

The five sleeves where this took place were:

- at Anchor and Hope Lane London at a cost of £61.2K
- at Busby Way Greenwich at a cost of £53.3k
- at the junction of the M27 / A3 at a cost of £45k per sleeve – where 3 sleeves were treated.

The works generally involve a full site set up, a full traffic management plan and an extensive works site to allow installation of grout into the sleeve. Any surplus grout has to be disposed of by a specialist waste disposal company. Once these projects are completed, we will have spent a total of £250k on remediation of these nitrogen sleeves during GD1 and believe it is appropriate to continue this programme during GD2.

Security

Coastal Erosion

Coastal erosion has become an increasing problem during GD1 as a result of climate change and extreme weather conditions being experienced. As a result, pipes that run close to or under the sea or a river are at risk of being exposed and therefore an increased threat to damage or accelerated deterioration. To manage the risks associated with these pipes, SGN undertake specific site surveys in accordance with our procedures SGN/PM/MAINT/14 and SGN/PM/MAINT/15 which involves carrying out a risk assessment of the pipe crossing.

During GD1 (up to March 2019) we have had four major pipe exposure incidents (three in Scotland and one in Southern) and three minor IP pipe crossings incidents as a result of land erosion. It is expected that due to the effects of climate change and global warming this will be a growing trend and we expect to experience an increase in the number of incidents we encounter.

There is no standard solution to address land erosion or damage to the pipe as this will be project and site specific but typical options or solutions that may be considered include:

- Large rocks and backfill to construct new river banks, riverbed, cover for pipe etc.
- Material for river diversion
- CP (cathodic protection) remediation
- Coating repair
- Pipeline repair/diversion
- Tree planting (roots help hold soil in position)
- Brash (tree branches), Willow spiling, small trees used to reduce effects of erosion.

The images in Figure 7 show newly installed terraced willow spiling for bank protection (left image). The same bank is also shown 1 year later (right image).

Figure 8 display some examples of where SGN had to undertake remedial works to protect or reposition our pipeline following coastal/river erosion.

Figure 7: Example of Newly Installed Terraced Willow Spiling (*Images property of SEPA – Scottish Environment Protection Agency*)



Security

In April 2018 we had an incident at a river crossing where a 180mm MP PE main had become exposed as a result of land erosion. The route of the MP main crossed agricultural land before crossing below **Security**

. The river had eroded the north bank and left the 180mm PE main exposed along a section of some 15m. As an interim solution, SGN covered the main with earth and sandbags until a permanent solution was determined.

The solution was to work upstream of this exposed main and rebuild part of the eroded banking to divert the water flow. This allowed the team to place a mesh over the main and infill the affected area with locally sourced materials to allow us to achieve the proper cover on this main. This solution avoids the need to lay 75m of 180mm MP PE which included a river crossing.

Figure 8: **Security**

Security

In January 2018 we had an incident at a seafront at **Security** where a section of the sea wall had been washed away by erosion. The 250mm MP PE main in **Security**, is laid along the footpath next to the sea wall. Unfortunately, a section of the sea wall had been washed away leaving the main exposed. This was the second time in seven years a section of the wall had been washed away, the first section, an 8" DI main, had been exposed and was replaced with a 250mm MP PE main which was laid in the opposite footpath. The main was in a vulnerable position, which put at risk the integrity of supply to the towns of **Security** that fed approximately 3,000 customers.

Figure 9: **Security**

Due to these experiences in GD1 and the future likelihood of more occurrences due to climate change, we have included investment within our GD2 proposals to be able to deal with erosion issues as they arise. There is further detail provided on this under the uncertainty mechanism for Environmental Resilience.

Figure 10: **Security**

Figure 11: **Security**

The river section of the pipeline has been between 0m to 0.4m of cover, with a bed material of mud and stone. On the east bank, the cover was between 0m to 1.1m and on the west bank cover varies between 0.2 to 2.3m.

Governors / PRIs

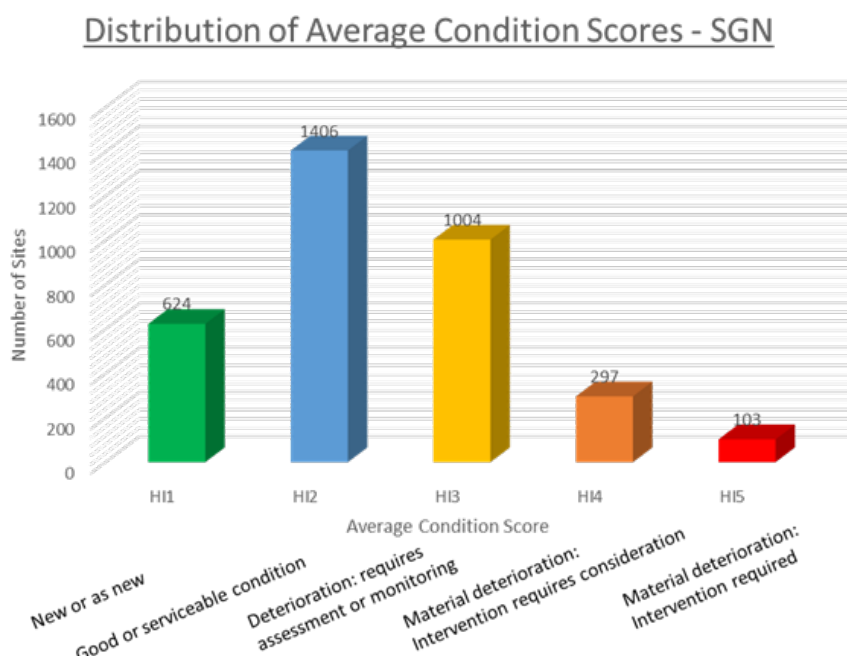
During GD1 we have implemented a comprehensive inspection and condition assessment regime on our governor population under our SGN Management Procedure SGN/PM/CM/4 part 2. This process of inspection allows us to health score whole sites and individual components within the site, which are being used to inform our investment decisions in the latter part of GD1 and going forward into GD2. The health scores range from 1-5 with 5 being worst as shown below in table 7.

Table 7: CM/4 Health Indices

CM/4 Health Index	Description
HI1	New or as good as new
HI2	Good or serviceable condition
HI3	Deterioration requires monitoring
HI4	Material deterioration - intervention requires consideration
HI5	End of serviceable life

Figure 12 shows a profile of health scores for SGN based on the survey results captured to date. These support the approach to make condition and compliance-based investment decisions which may previously have been heavily weighted by obsolescence. More detail on the specific findings from these condition assessments can be found in section 6.2 of this appendix where we discuss our proposed outputs.

Figure 12: **SGN Average Condition Scores**



Below Ground Governor Security – Refurbishment and Replacement

In some areas it is often not possible to put governors above ground, as they need to be kept away from a densely populated urban environment or the Local Authority / Land Owner does not want a governor kiosk installed. These types of installation are commonly found in densely trafficked carriageway areas and conservation areas, with the pits in which the governors are located protected by load bearing covers such as an Elkington Gatic cover. These covers are, given their age and the environment they are in, showing significant signs of deterioration. The construction of these covers is predominately steel and concrete which makes them extremely dense and require a manual two man lifting operation in order to provide access and protection.

SGN has over 1,800 below ground governor installations. During GD1, these units have been included within the portfolio of assets which CM/4 Part 2 surveys have been carried out on. The results of these surveys will help inform and prioritise our work programmes moving forward also identifying specific risks that need to be dealt with at an early stage. This will be a further area where that is the case.

With the increased volume of road traffic year on year, fatigue and vibration from vehicles running over, moving or passing in close proximity, are causing structural damage to the pit lids and walls. Water ingress and road salt are also damaging the pits brick and concrete structure. Due to the condition and structure of these covers it is not possible to remediate, repair or refurbish, which means replacement is the only option.

To date in GD1 (end of March 2019) SGN have remediated 16 sites that have Gatic covers in southern Network. The number of Gatic covers per site can vary ranging from as little as 2 to as many as 48, depending on the size of the below ground governor.

We propose to continue this investment during GD2 as part of an on-going programme that will ensure we maintain a safe and secure network and enable SGN to continue to comply with HSE manual handling requirements moving forward.

Figure 13:

Security

Figure 14:

Security

Governor Asbestos Management – Building and Plant Refurbishment and Replacement

Within SGN we have 7,479 below 7 bar governor sites, 2,333 in Scotland and 5,146 in Southern. When these governors were installed asbestos would have been commonly used within the housing and gaskets.

During GD1 SGN has surveyed 15% of its governors to identify and remediate the removal of asbestos from its sites, investing £187,809 (£150,000 in Southern covering 180 sites and £37,809 in Scotland covering 49 sites). The relatively low spend in GD1 is expected to increase significantly to fully survey the remaining 85% of our governor and kiosk portfolio. This will however result in a corresponding increase in remediation costs.

During GD1 we have reactively managed the risk of asbestos when it has been identified and trained our employees on how to identify it and contain the risk.

As a responsible employer we have a duty of care to our employees with regards to protecting their health from the exposure to asbestos and complying with legislation such as the Health and Safety at Work Act 1974. To fulfil that requirement, we will continue to manage the risk and identify the sites into GD2 and beyond and the costs required to do this during GD2 form part of the proposals set out in this appendix.

Figure 15: **Photo Examples of Asbestos**



4 GD2 Stakeholder Insight

We have undertaken a comprehensive programme of engagement and research during the development of our GD2 business plan, helping us to understand our customers' and stakeholders' priorities. This is described in more detail in chapter 4 of our business plan and the Enhanced Engagement appendix (022).

In GD1 we have sought a foster relationship across multiple stakeholder platforms, to develop a view not only of growth and development at local and national level, but of future energy strategies and demand profiles.

However, this initiative has not only better informed our view of likely development and level of investment requirements, it also generated a number of relationships with parties which lead to far more wide-reaching discussions around investment plans and the challenges involved in not only ensuring capacity was available to support growth and infrastructure but also the costs and complexities associated with maintaining and operating existing networks to provide the platform for that growth.

On occasion such discussions involved other utilities, many of whom work within similar regulated frameworks and with similar technical challenges. Common themes emerging from those discussions included:

- a desire for all parties to work together in a joined-up way;
- that infrastructure providers will not become a 'blocker' to timely construction and delivery of those plans;
- that current levels of reliability of the gas network were maintained; and
- the desire for increased coordination between infrastructure providers to minimise disruption

Decisions on whether to replace or maintain distribution assets in GD2 will depend on a number of factors. The potential impact of new technology, policy decisions on the future role of the network and in particular the flows and types of gasses within the system will have critical bearing on our GD2 investment strategy. We have tested this with customers and stakeholders through our engagement and research.

Our customers and stakeholders have told us that network safety and resilience is very important to them. However, in recognising the importance, they have also indicated that they do not see this as an area requiring additional focus or increasing levels of expenditure as they consider current performance in GD1 as very good (see section 7 for more information). As a result, we have taken these views into consideration when developing our approach to focus on repair and refurbishment as priority interventions for maintaining network integrity.

Above and below ground rail and river crossings are a specific area where we will be engaging with stakeholders with regards to our integrity works and fully expect feedback and evidence from our stakeholders to support our decision making. For example, if we need to work on or remove a pipe over a railway line we will have to work very closely with Network Rail to understand their requirements and track possessions which will affect the engineering methods we use and time it takes to do the works and plan the job. Also, for river crossings, there will be environmental concerns and factors that we will need to consider such as impact to trees and wildlife.

4.1 Positive Impact

We know our customers and stakeholders value safe and reliable gas supplies. Domestic customers, and in particular those who are vulnerable or at risk, can experience significant negative consequences if their gas supplies are interrupted for a prolonged period.

To ensure our customers don't experience prolonged gas outages we invest to improve the resilience of distribution assets. An example was highlighted in the Newton Stewart grid, where an existing governor which had operated without issue for many years was subject to an extreme weather event (flooding). To ensure that the customers were not doubly inconvenienced with flooding and the loss of their gas supply, the governor was moved to higher ground (see Figure below).

Figure 16: An Extreme Weather Event (Flood) in Newton Stewart Triggered Relocation of a District Governor to Higher Ground.



Our network also supplies a number of very large gas users, such as power generators and industrial manufacturers. We have engaged with this group of stakeholders specifically. These stakeholders have clearly indicated that a prolonged unplanned interruption in gas supplies would significantly damage their businesses, as detailed in section 7.

The Glasgow City Region Operational Infrastructure Group is a very good example of a proactive initiative in respect of planning for the future. The Glasgow City Region area covers a third of Scotland's population and generates a third of its economic wealth. At a Strategic Infrastructure Summit, held in September 2017 joint agreement was reached between 8 local authorities covering the west of Scotland and major infrastructure providers operating within the area to best consider how to maximise over £1 billion of City Deal investment in the Glasgow city region. This subsequently led to setting up of the Operational Infrastructure Group (OIG), which featured key representatives from the eight affected local authorities and a range of utilities.



That group now meets on a regular basis covering a range of topics, and while there is a focus on development, it has created a significant platform for the sharing of ideas, collaboration on projects, a greater understanding of the respective networks and challenges, the importance of key infrastructure and need to maintain the integrity of that network. Feedback reflects an expectancy that such arrangements are in place and current level of reliability are a given and should not be compromised into the future.

4.2 Shared Future



Customers and stakeholders have told us exploring future energy solutions is an area they would like to see prioritised for investment. At our Moving Forward Together workshops, we engaged with stakeholders to discuss their views in relation to keeping pace with technological changes and making our network 'smarter'. We worked with stakeholders to design criteria that could be applied when making investment decisions, which revealed future-proofing the network is one of the most important factors to consider.

Our willingness to pay research with customers asked them to value potential improvements in our business. One such improvement was designing our network to transport greater amounts of 'green' low carbon gas to help the UK meet its long-term targets on climate change. We also explored these considerations with customers in our business plan acceptability testing qualitative workshops and quantitative research. The results showed that customers consistently rate future energy solutions as a high priority for further investment.^{1,2} Further detail is provided section 7 – Stakeholder annex.

¹ Explorative Qualitative Workshops and interviews (Exploratory Phase) (Ref: 002)

² Conjoint & WtP Summary report (Valuation Phase) (Ref: 005)

Minimising our environmental impact is an area our customers want us to focus on in GD2. We are also working towards further positive impact on the environment with projects such as solar photovoltaics (PV) on governor installations to reduce the need for batteries which will have a reduction on requirements to visit the site to replace them but also the hazardous waste associated with them. Another good example of positive impact on the environment is the Remote Pressure Management project which will allow remote monitoring of network pressures and will ensure that gas emissions from shrinkage and leakage are significantly reduced. More detail on these projects can be found in the annex at the back of this appendix and the Environmental Action Plan (EAP) (appendix 003).

4.3 Safety & Efficiency



The customer and stakeholder priorities of acting safely, keeping the gas flowing and keeping costs down are core to guiding the decisions that we are making within our distribution integrity proposal for GD2. Our engagement programme has revealed that customers and stakeholders see these priorities as of paramount importance, as described in more detail in Section 7 – Stakeholder annex. At our Moving Forward Together workshops in November 2018, stakeholders shared their views in relation to distribution integrity investment decisions that would improve resilience and security. Feedback from this engagement is again detailed in Section 7. ‘Our Willingness to Pay’ research with customers has also given us insight into their willingness to contribute more to safety initiatives such as relocating pipes to reduce the risk of damage and enhancing the physical security of our sites and further insight has been gained from our business plan acceptability testing.

A further example of the strong relationships we have built has been with the Greater London authority (GLA). Initial discussions with their Growth and Infrastructure Department led to further discussions with their environmental team and to an involvement in the development of the London Resilience Partnership Strategy. Discussions took place with SGN outlining the level of resilience within the existing heavily integrated gas network across London and key assets and elements of that system. Critically we received very strong feedback regarding the value of the network to the prosperity of London and the need to continue to maintain the system and ensure the current level of reliability. Such signals from this engagement and that of the West of Scotland were reflected in other similar discussions. We believe that having received such feedback from the two groups which cover the most heavily populated areas within each of our networks provides us with great reassurance that our plans are appropriately targeted and reflective of our stakeholders’ expectations.



5 RIIO-GD2 cross sector issues

5.1 Decarbonisation & Whole system

This appendix is focused on activities and associated investment required to ensure maintenance of current levels of system integrity, ensuring that the system remains safe and reliable, and that we manage risk appropriately. To do this we have focused on our 4Rs strategy: Repair, Refurbish, Replace and Rebuild.

The proposals set out in this appendix are unaffected by the different potential energy scenarios that are set out in the Energy Futures - Whole Systems and Scenarios appendix (007) as each of the projects identified are required in order to appropriately manage risk and maintain system integrity of the Distribution network during RIIO-GD2.

In fact, were the role of the gas networks within the future decarbonised energy system more firmly established, it is possible that some of these projects currently proposed as refurbishment may have been considered on the basis of a full rebuild. In that sense, we have looked to develop, sensible, pragmatic and flexible solutions.

Our integrity works can have an impact on the environment which we are aware of such as traffic disruption and noise. We minimise this impact by strategically planning our works out of busy times and during holiday periods. We can also work closely with the local authority and residents so as to understand their needs and requirements and explain the reason why we need to complete our works.

Supporting a low carbon network is important for the future of gas and ensuring it is part of the energy mix. Hydrogen is leading the way for us with our collaborative H100 project progressing well and to plan. In addition, we are engaged with our partner ERM in bidding for funding from the Scottish Government's Low Carbon Infrastructure Transition Programme. This is to look at the wider scalability of hydrogen generation in project H100. We are also developing a consortium bid into BEIS's supply competition, where with partners we'd look to build a hydrogen demonstration project using ORE Catapult's 7MW offshore wind turbine providing the primary energy.

As part of integrity works and where we are replacing an existing main we can review the future impact for hydrogen and whether the works we are doing will allow for the mains to be future ready for hydrogen, thereby removing future costs to upgrade the network for hydrogen.

Senior government and business leaders continue to highlight the pivotal role Britain's gas networks have in delivering a cleaner, smarter and more efficient energy system for the public, in a wide-ranging survey carried out last autumn. Close to 80% of stakeholders surveyed see the gas transmission and distribution networks as having a continued key role for heating. Our networks, therefore, are a critical piece of national infrastructure, underpinned by decades of investment which provide reliable, secure and flexible source of energy - UK wide.

Clearly there is a certain amount of uncertainty in this area at present. However, it is expected that during the course of GD2, as further innovation takes place and Government Policy emerges, a more clearly defined pathway will emerge. As a result, a degree of flexibility will be required in our thinking, mindful of the possibility that our network at some future point may be required to transport alternative fuels such as hydrogen. This could result in acceleration to 100% PE networks sooner.

5.2 Innovation

We are currently developing and delivering a significant portfolio of innovation work with progress in many areas. One example of a project now in use is the Commercial Confidentiality tool which supports our work on monetised asset risk and to date has identified £4.9m of benefits. This has been invaluable in developing GD2 workloads, proposals and outputs. Further development of the system as it is integrated into our business will continue into GD2 and will help develop more economically targeted thinking around development of replacement programmes.

Collaborative work with water companies to install a new type of valve which will close when water is detected in our mains is also ongoing. As part of a trial with Thames Water, the **Security** valves will be installed close to higher risk water mains, providing our network with greater protection from the disastrous consequences of potential water ingress. This would mean less water ingress incidents, less supply interruptions, an improvement in customers experience and significant reduction in costs associated with such incidents.

We are using innovation to help us, and our industry, address the pressing issue on 'the future of gas' and how we are collaborating with others to help change the face of the industry as it is today. This is through a flexible approach to decarbonisation, the growth of 'green' gases (such as hydrogen) and the revision of gas quality specifications, all to help the UK meet its climate change targets, but also critically to reduce associated costs, as with the first two examples, which ultimately will lead to reduction in customers' bills.

For example, one of the Network Innovation Competition (NIC) schemes we are charged with is our 'Real-time Network' trial in Kent, which is an initiative designed to give detail about the calorific value of gas supplied to homes and will produce a wide range of data which could help us and others run our networks in much smarter ways and at the same time, accept different specifications of blended gases.

Using the innovation allowances from the Ofgem mechanisms available we are driving operational excellence through innovation and technology to deliver real benefits to customers which can be demonstrated by the following examples of our commitment over GD1, more detail on which can be found in the Innovation appendix (008) and Repex appendix (019). These include:

- Minimising disruption:
 - Seven operational core and vac machines in operation
 - CISBOT robots have travelled over 14.4km carrying out essential refurbishment
- Keeping the gas flowing safely:
 - Self-amalgamating tape has transformed our approach to riser pipe risk management significantly reducing the number of disconnections
- Improving our service:
 - Live main insertion techniques reducing the number of customer interruptions / minimising disruption.

Our governor innovation projects have taken many forms: from process improvements to the research and development of new engineering techniques, products and services. It's all about embracing change to continually evolve and make engineering and safety progress, benefiting both the customer and the environment. We are working with other GDNs to create the Gas Network Innovation Strategy, with the ambition of delivering innovation excellence to the wider gas business.

Our integrity plan is looking to build on and utilise current innovative techniques, but also those that are still to be proven in the remainder of GD1. An example of this would include an innovative precision performance pressure regulator developed by the manufacturer Oxford Flow, that is compact in size and has only one moving part, making the regulator virtually maintenance free. This would be a world's first. SGN have partnered with **Commercial Confidentiality** under the Network Innovation Allowance (NIA), embarking on an innovation project which looks to develop improved Pressure Reduction Installation (PRI) designs based on the **Commercial Confidentiality** regulator concept and other associated technologies, such as the **Commercial Confidentiality**, filter and silencer, to evaluate their application for use with natural gas pressure reduction from 7bar to 2bar. It is expected this new technology has the potential to make a significant impact on the lifetime cost of low and medium pressure PRIs, as well as a reduction in noise and environmental issues. Other expected key benefits are that there will be improved long-term reliability and a significant reduction in maintenance due to the lack of moving parts involved with the regulator's operation.

Figure 17: West Kilbride - before and after installation of maintenance-free, OxFlow Regulators



Table 8: Completed Innovation Projects Undertaken in GD/1

Innovation Projects	Safe and Efficient			Positive Impact		Shared Future	
	Acting Safely			Keeping the Gas Flowing		Keeping the Costs Down	
Sections	Improved Safety	Reduced risk of injury to life	Reduced likelihood of Interference damage by third parties	Improved Integrity of Supply	Reduced risk of supply interruptions	Extended Asset Life	Improved network efficiency & reduced carbon footprint
Starline/Marwin Valve Bolt Replacement	✓	✓		✓	✓	✓	✓
Novel Pressure Reduction Station (Stage 1)	✓	✓		✓	✓		✓
Acoustic Communications in Gas Mains	✓			✓	✓		✓
Wireless Instrumentation Field Trial	✓	✓	✓	✓	✓		✓
Smart Paints and Coating Systems	✓				✓	✓	✓
Magnetic Filtration in Medium to Low Pressure Networks	✓	✓		✓	✓		✓
Corrosion Mapping System for Buried Orpheus Regulator Modules – Phase 2	✓	✓		✓	✓	✓	✓
Automated Regulator Maintenance (ARM) (Phase 1)	✓	✓		✓	✓	✓	✓
Tornado Max	✓	✓					✓
Osprey Pressure Validator	✓	✓		✓	✓	✓	✓
Small Pressure Pot	✓	✓		✓	✓	✓	✓
RCA GPS Survey	✓	✓	✓				✓
Bar Hole Zone Rating (Stage 1)	✓	✓		✓	✓		✓
Advanced Gas Detection	✓	✓		✓	✓		✓
Robotic Roadworks (Stage 1)	✓	✓	✓		✓	✓	✓
Incident Management (Stage 1)	✓	✓					✓
High Volume Gas Escapes (Stage 1)	✓	✓			✓		✓

Table 8 demonstrates the innovation projects that have been implemented during GD1, on which more detail can be found in the Innovation appendix (008). During GD2 we'll continue to work closely with our innovation colleagues, collaborate with other networks and other key stakeholders wherever possible to continue to develop new technologies and processes which will provide future benefits and improve efficiencies particularly for the customer.

5.3 Resilience

GD1 has seen increasing challenges for maintaining distribution network integrity, with one of the main potentially unpredictable challenges coming from the severe and extreme weather patterns. Unpredictable weather phenomena have become more frequent and is adversely affecting both our Scotland and Southern Networks. These cold weather spells have been followed by high summer temperatures, both causing ground movement and damage to structures, supports and building foundations.

The impact of climate change is being seen now. In 2016 and 2017 we have seen severe flooding in parts of the UK not witnessed for over 100 years with rivers, burns and ditches bursting their banks. Our customers in Scotland have seen communities flooded, with streets abandoned to rising flood waters, along with businesses and homes destroyed. We have numerous gas mains exposed across our networks, these gas mains and associated pressure reduction equipment were put under severe risk of failure due to the severity of the flooding. This is an emerging issue which will increase and add further risk to security of supply on our Networks.

These unfamiliar weather patterns of hot, cold, dry or wet conditions significantly contributed towards accelerated corrosion and deterioration on pipes, buildings and structures in a random and unpredictable manner. For example, in 2018 we had the 'Beast from the East' during the winter followed by one of the hottest summers on record.

These challenges experienced during GD1 have helped inform our decisions into GD2 and has identified that we are likely to experience similar events in the future that we must be prepared to remediate as the issues arise.

The prevention and remediation of environmental erosion is important, because exposed assets increase the risk to our network. The reduction or complete removal of cover reduces the protection on the pipe and increases the likelihood it can be damaged by third parties.

Types of environmental erosion:

- Rill Erosion: This process develops small, short-lived, concentrated flow paths. These paths create a sediment source and delivery system for hillslope erosion. Areas where precipitation rates exceed soil infiltration rates are more prone to this type of erosion.
- Gully Erosion: Water flows in narrow channels during or directly following heavy rains or melting snow. The gullies can erode to considerable depths.
- Valley or Stream Erosion: Continual water flow alongside land (along a linear feature) creates this type of erosion. It extends downward, deepening a valley, and headward, extending the valley into the hillside. This occurs most frequently in times of flooding.
- Bank Erosion: Over time, banks of rivers and streams are naturally worn down.

In IGEM/TD/3 the standard for 'Steel and PE pipelines for gas distribution' it states that the design of a pipeline at a water crossing should take in to account "geology, environmental, currents stability and erosion of bank and beds." The funding requested is not only to protect the integrity of our assets but also to meet the requirements stated in IGEM/TD/3.

6 GD2 activity breakdown

In GD2 we will need to replace or repair assets that are aging or failing and are showing significant signs of deterioration. In some cases, assets will be past their intended design life or are no longer compliant with changing industry standards. They have the potential to generate significant risk and safety consequences to network supplies, operatives and customers.

- In Southern, we own and operate 508 networks, operating at below 7bar, with approximately 48,000km of mains, from which SGN supply the majority of the 4.1 million customers.
- In Scotland, we own and operate 456 networks, operating below 7bar, with approximately 23,500km of mains from which SGN supply majority of the 1.8 million customers.

Our customers and other stakeholders have told us they place a very high value on security of their gas supply. To continue to operate and maintain a safe, secure and reliable gas supply network, we need to ensure all of our assets remain fit for purpose. Our approach to GD2 is to deliver the core 'here and now' requirements of safety and resilience but also to support decarbonisation of the network that can support greener and/or renewable sources of gas.

The proposed works will be carried out with a mix of direct labour and contract labour. For the smaller on-going programmes of works such as battery replacements for loggers we will continue to use direct labour. However, for the larger projects such as **Security** we will employ a tender process and use external contractors as we do not have the required expertise and resources internally to deliver this type of project.

6.1 Approach to GD2

In GD2 we plan to invest £85m in maintaining distribution network integrity. Distribution network integrity crosses an extensive asset base of 71,645km of pipe, 7,479 district governors, 1,621 Industrial and Commercial (I&C) governors, 29,179 service governors and 38,620 valves. We have an extensive programme of surveying these assets and have taken a risk-based approach to determining the expected workload. Our approach to GD2 is to deliver the core 'here and now' requirements of safety and resilience but taking due consideration of the decision BEIS will take regarding the long-term future of the Gas Networks during GD2 and the decarbonisation work of the Gas Distribution Network companies.

Throughout GD1 we have maintained a 4Rs strategy of Repair, Refurbish, Replacement and Rebuild, focusing on asset repair where possible and then moving to more intrusive interventions where necessary.

We expect the challenge of sustaining network integrity to increase as we progress through GD2. The unpredictable challenges coming from the severe and extreme weather as climatic changes appear to have greater impact on our environment. The frequency of more extreme weather phenomena is adversely impacting both our Scotland and southern networks. Recent cold weather spells have been followed by high summer temperatures resulting in ground movement and damage to structures, supports and building foundations not designed or built for such rapid changes and extreme conditions. This undoubtedly influences our integrity workload as we manage and maintain the assets health. When changes to the amount of gas required necessitate an asset to be rebuilt or replaced to ensure security of supply then this is identified in the Capacity Management appendix (018).

The second major challenge is how we respond to climate change. Under both our licence and our Health and Safety requirements we need to deliver a safe and reliable network. There are multiple scenarios for how the UK decarbonise the energy sector and the economy according to the relative costs of each. We consider it unlikely that this will be achieved without the gas networks, but even if that should be the case then we are required to maintain a safe network until the point of full decommissioning.

Rather, we consider it more plausible that the network will form an essential part of the decarbonised economy, and as a result we will need to maintain our assets to be a part of the future energy mix, enabling the transportation of increasing blends of decarbonised gas.

As a part of this we will need to continue with existing programmes such as: maintaining cathodic protection (CP) systems on steel pipelines, maintaining pipe crossings and Valves; refurbishing and replacing existing assets as necessary in order to operate a safe and secure network. This programme of work will also involve reducing long term network costs and societal risk such as releases of gas, member of the public injuries, traffic jams and impact our work has on the local communities and economies as part of our drive to reduce customers' bills.

We recognise there is uncertainty here. However, our plan is focused on refurbishing and maintaining existing assets wherever possible until there is greater clarity and policy direction. If this is forthcoming, then we will revisit this assumption as a part of Ofgem's proposed future of heat reopener and re-assess whether a longer and more certain asset life would change any of the decisions in favour of a more substantive intervention. This strategy ensures that investment in GD2 will be based on a 'no regrets' policy (discussed at length in the Business Plan).

The Network Integrity asset categories requiring funding are:

- **Coastal Erosion** - the remediation, inspection or replacement of below ground coastal and river crossings.
- **Valves** – the remediation and upgrade of valves within the low, medium and intermediate pressure systems.
- **Gas Profile & Logger System** – the operation of a communication network (telemetry and Pressure Management and Control (PMAC)) to monitor sites and to control them as necessary. If they fail it will lead to higher pressures in the distribution network.
- **Cathodic Protection** – the remediation of steel distribution mains and the upgrade of IP and MP steel mains systems.
- **IP Marker Posts** – the remediation, inspection and replacement of existing IP marker posts on IP pipelines.
- **Nitrogen Sleeves** – the inspection, remediation and refurbishment of existing Nitrogen Sleeves pipes.
- **Tunnels** – the inspection, remediation and refurbishment of existing pipes in tunnels.

We are proposing to invest some £19.35m in Southern and £8.15m in Scotland to maintain the integrity of our operational assets across the distribution networks.

Governors

In both our networks for governor refurbishments and replacement we propose to invest, £43.39m in Southern and £14.09m in Scotland. This is a combined total investment of £57.48m in our <7bar governors portfolio. This investment is required order to manage, maintain and improve the condition, reliability and operability of our assets.

The Network governor assets categories requiring GD2 intervention funding are:

- **Distribution governors** – refurbish or replace, due to asset health profile ranking
- **Below ground governor security** – refurbish or replace due to asset health profile ranking
- **Governor asbestos management** – replace due to employee safety and /or asset health profile ranking
- **Domestic and industrial & commercial service regulators** - refurbish or replace due to asset health profile ranking.

Table 9: RIIO-GD2 Investment proposal (£m 18/19 prices)

SGN (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.91	0.75	0.00	0.00	0.00
Protection									1.71	1.63	1.62	1.62	1.62
Data Loggers									1.16	1.11	1.10	1.10	1.11
Valves									1.11	1.06	1.05	1.05	1.06
Environmental									1.89	1.78	1.02	1.02	1.03
Governors									11.46	11.37	11.53	11.53	11.59
Governors & Integrity GD1	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44					
Total	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44	18.25	17.70	16.33	16.32	16.41
Scotland (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.11	0.00	0.00	0.00	0.00
Protection									0.49	0.49	0.49	0.49	0.49
Data Loggers									0.43	0.43	0.43	0.42	0.43
Valves									0.43	0.43	0.43	0.43	0.43
Environmental									0.26	0.26	0.26	0.26	0.26
Governors									2.69	2.69	2.88	2.89	2.94
Governors & Integrity GD1	3.42	9.49	3.20	2.52	2.62	2.90	3.36	3.77					
Total	3.42	9.49	3.20	2.52	2.62	2.90	3.36	3.77	4.41	4.31	4.48	4.49	4.55
Southern (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.80	0.75	0.00	0.00	0.00
Protection									1.22	1.14	1.13	1.13	1.13
Data Loggers									0.73	0.68	0.67	0.67	0.68
Valves									0.67	0.63	0.62	0.62	0.62
Environmental									1.63	1.52	0.76	0.76	0.77
Governors									8.77	8.67	8.65	8.64	8.65
Governors & Integrity GD1	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66					
Total	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66	13.83	13.39	11.84	11.82	11.85

Hatched areas do not have directly comparable data for GD1 as it was not separately identified in this manner

6.1(b) Impact of Government Policy

We believe our investment proposals set out the minimum requirements in order to maintain and operate safe and reliable networks. SGN have applied our 4 Rs strategy to explore the possible options for repair or refurbishment as an alternative to full replacements or rebuilds. Due to the uncertainty of the future of gas networks and the awaited decision from BEIS, we have in some cases opted for refurbishment as the best short to medium-term option until a future decision is made.

Once there is greater clarity on the direction of government policy, we may review our current proposals to ensure they are the optimum solutions for the long-term benefits of the gas networks and our customers. This could have an effect on the numbers set out in the BPD, where we have opted for refurbishment as the most appropriate short-term solution. We have captured legislative change as a reopener under uncertainty

mechanisms that covers a broad range of areas that could be impacted either by policy changes from Government or from the HSE.

6.1(c) Scenarios and Sensitivities

For each investment proposed within this appendix, there is a separate CBA and engineering justification paper. These discuss the different scenarios or specific options possible in relation to the SGN 4 R's strategy and each of these will specify a preferred option.

We have then carried out sensitivity analysis in relation to this option on variables, based on uncertainties we may experience during GD2, as detailed below, to see what impact this may have on the proposed option and what the impact is on the NPV and payback periods if any.

The sensitivity analysis has been conducted in the form of a "High" and "Low" position, which is compared to the "Mid" position that is used for the submission. The "Low" and "High" cases use a +/- 5% swing on each variable to build an illustration. The variables adjusted are as follows:

- Capital Cost
- Maintenance and Repair cost
- Methane content (fixed time series data)
- Societal Benefits (loss of supply/ HSE fines/ building damage)
- Fatal/ non-fatal injuries
- Leakage (CH₄).

5% is used as a variance as we do not expect, nor have we seen, any large-scale unexpected movements in price or workload associated with maintaining and/or replacing these assets.

The results of this sensitivity analysis are included in a table within section 9.3 of each Engineering Justification Paper but show that the overall sensitivity to change in variable is negligible. The effect on the payback periods is minimal across Low and High positions.

6.2 GD2 Output & Price Control Deliverable

Outputs

As governors are the only asset category within this appendix directly defined as a NARMS output, all other investment proposed within this appendix are defined as a price control deliverable.

The below table shows the proposed NARMS output for governors which for district governors is inclusive of replacements, abandonments and kiosk replacements. For I&C and service governors it is replacements.

Table 10: NARMS GD2 Output (Governors)

Asset Group	Output	Units	Southern	Scotland	SGN
District Governors	NARMS	£	£445,813.33	£235,265.20	£681,078.53
I&C Governors	NARMS	£	£300.54	£399.89	£700.44
Service Governors	NARMS	£	£251,805.49	£32,419.52	£284,225.02
Total (NARMS)	NARMS	£	£697,919.36	£268,084.62	£966,003.98

All figures shown in the above table are for GD2 (5yr period).

Governors - Asset Health

Our GD2 governor investment plan is structured to enable a 'no regrets' investment strategy to be employed until there is greater confidence on the role of the gas networks in the decarbonised energy system. This investment strategy has been guided by our CM/4 asset health inspection regime which provides an indication of the current condition and will also support, with review, how the assets deteriorate over time as this is an ongoing programme of condition monitoring assessments. The CM/4 process is our primary driver for the replacement of governors that are nearing the end of their engineered design life, through condition and obsolescence.

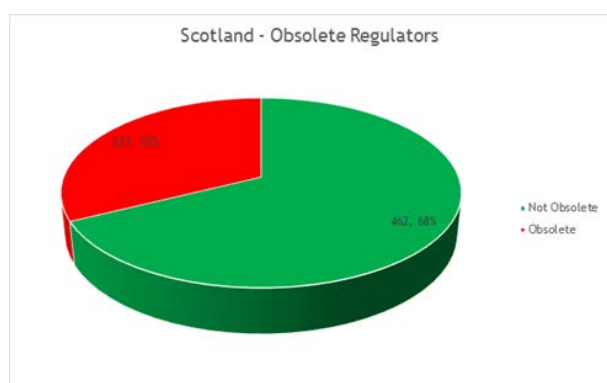
As described in the table in section 3.6, HI4 and HI5 suggest material deterioration and an intervention should either be considered (HI4) or undertaken (HI5).

Scotland - CM/4 Technical Assessment Survey Results (Data and graphs as of 1st April 2019)

- 32% of our governors are classed as obsolete with no spare parts available to repair if these fail (SGN currently cannibalises parts from replaced governors, this is not sustainable)
- 7% of governors have a civils score of HI4 or HI5
- 2% of above ground governors have an overall corrosion score of HI4 or HI5
- 12% of above ground governors have a painting score of HI4 or HI5
- 40% of below ground (pit) governors have an overall corrosion score of HI4 or HI5
- 40% of below ground (pit) governors have a painting score of HI4 or HI5
- 76% of below ground (buried) governors have an overall corrosion score of HI4 or HI5
- 76% of below ground (buried) governors have a painting score of HI4 or HI5

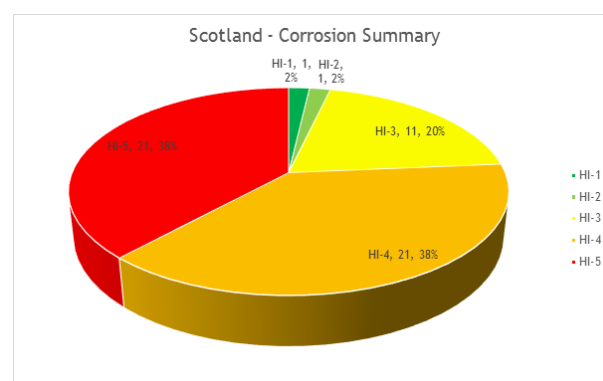
Scotland – Obsolete Regulators

Out of a sample size of 683 surveys, 32% of Scotland's regulators are obsolete with no hard or soft spare parts available



Scotland – Corrosion Summary

Out of a sample size of 55 surveys, 76% of Scotland's *below ground* (buried) regulators have an overall corrosion score within the HI-4 & HI-5 brackets where intervention needs to be considered.



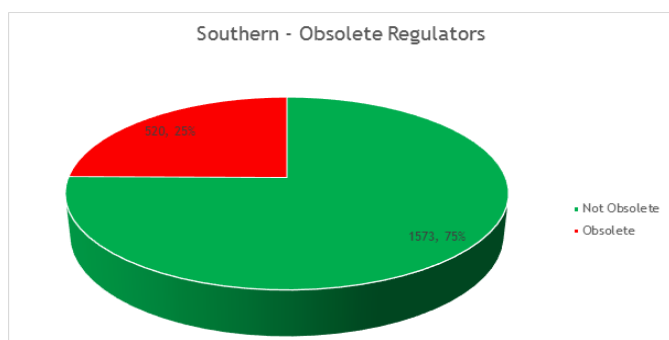
Southern - CM/4 Technical Assessment Survey Results (Data and graphs as of 1st April 2019)

- 25% of our governors are classed as obsolete with no spare parts available to repair if these fail (SGN currently cannibalises parts from replaced governors, this is not sustainable)
- 7% of governors have a civils score of HI4 or HI5
- 7% of above ground governors have an overall corrosion score of HI4 or HI5
- 17% of above ground governors have a painting score of HI4 or HI5

- 19% of below ground (pit) governors have an overall corrosion score of HI4 or HI5
- 39% of below ground (pit) governors have a painting score of HI4 or HI5
- 29% of below ground (buried) governors have an overall corrosion score of HI4 or HI5
- 30% of below ground (buried) governors have a painting score of HI4 or HI5.

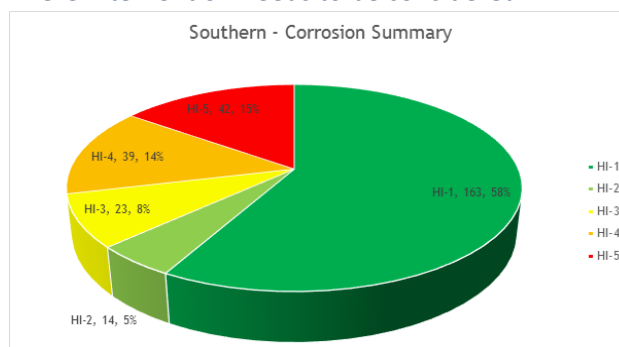
Southern – Obsolete Regulators

Out of a sample size of 2093 surveys, 25% of Southern regulators are obsolete with no hard or soft spare parts available.



Southern – Corrosion Summary

Out of a sample size of 281 surveys, 29% of Southern *below ground* (buried) regulators have an overall corrosion score within the HI-4 & HI-5 brackets where intervention needs to be considered.



The initial assessments and recorded condition scores support a prioritised programme of works based on condition and compliance as found on inspection. For condition, individual stream components and pipework are given a health score for paint condition and a score for corrosion condition. Civil equipment including housing, gates, fencing, security and locks etc. are also given a condition score. A total score can then be produced for an installation. In some cases, it may be relevant to use a total site score to support full replacement including housing, or in some cases the governor installation may be in good condition and fully compliant but only the housing requires replacement.

As well as our risk-based programme we have also identified specific named projects that will be undertaken. These are generally large installations that have been risk assessed and have a high condition score with significant impact on consumers in the event of any failure. Our CM/4 health and criticality inspections help confirm those assets that are at or close to the end of their natural design life due to a range of factors.

As you would expect, all our assets are aging, and they shall require to be replaced on their health and criticality risk score, with the highest scoring governors being replaced first.

Southern

Our southern network has an asset population of 5,146 district governors and we propose to invest £43.39m, an average investment of £8.68m over the 5 years of GD2 to:

- replace 197 district governors - 4% of our total governor population;
- replace 2,595 domestic service governors - 10% of our total service governor population; and
- refurbish 2,891 governors - 56% of our total governor population.

We are proposing for our Southern Gas Network to have 20 named governor projects in the GD2 period for a total investment of £8.37m. The 20 governors are high capacity governors or governors with IP inlets and due to the size and number of customers these governors supply, they are our highest ranked governors for risk and

criticality of gas supply. Each named project is supported with a CM/4 health and criticality assessment.

Table 11 shows the proposed Southern investment in categories that are reflective of those set out in the GD2 BPDT worksheet 3.03. Total costs are in row 12 and total workloads are in rows 32 and 41.

Table 11: Southern GD2 Investment Table (18/19 Prices)

Delivering a Safe Network	GD2 Average Funding per annum £m	GD2 Workload per annum	Total GD2 Workload	Total GD2 Period Funding £m
Governor IP Inlet	1.48	4	18	7.401
Governor MP Inlet	4.734	33	167	23.669
Housing IP Inlet	1.37	23	114	6.85
Housing MP Inlet	0.22	19	95	1.099
Refurbishment IP Inlet	0	0	0	0
Refurbishment MP Inlet	0.342	536	2682	1.71
Decommission IP Inlet	0	0	0	0
Decommission MP Inlet	0.052	1	5	0.26
Domestic Service Regulators	0.413	519	2595	2.065
I&C Non-Domestic Service Regulators	0.068	1	5	0.339
Total	8.679			43.393

Scotland

Our Scotland Gas Network has an asset population of 2,333 district governors and we propose to invest £14.09m, an average investment of £2.82m over the 5 years of GD2 to:

- replace 67 district governors - 3% of our total governor population;
- replace 355 domestic service governor - 10% of our total service governor population; and
- refurbish 519 governors - 23% of our total governor population.

We are proposing to have 15 named governor projects in the GD2 period for a total investment of £5.65m. The 15 governors are high capacity governors or governors with IP inlets and due to the size and number of customers these governors supply, they are our highest ranked governor for risk and criticality of gas supply. Each named project is supported with a CM/4 health and criticality assessment.

Table 12 shows the proposed Scotland investment in categories that are reflective of those set out in the GD2 BPDT worksheet 3.03. Total costs are in row 12 and total workloads are in rows 32 and 41.

Table 12: Scotland GD2 Investment Table (18/19 Prices)

Delivering a Safe Network	GD2 Average Funding per annum £m	GD2 Workload per annum	Total GD2 Workload	Total GD2 Period Funding £m
Governor IP Inlet	1.225	3	15	6.126
Governor MP Inlet	1.095	9	45	5.476
Housing IP Inlet	0	0	0	0
Housing MP Inlet	0.231	18	90	1.157
Refurbishment IP Inlet	0	0	0	0
Refurbishment MP Inlet	0.058	86	429	0.29
Decommission IP Inlet	0	0	0	0
Decommission MP Inlet	0.023	0.4	2	0.116
Domestic Service Regulators	0.1	71	355	0.502
I&C Non-Domestic Service Regulators	0.085	1	5	0.424
Total	2.817			14.091

A standard governor has an expected lifecycle of 45 years and an aging governor population will increase the risk of failure in the future, with the corresponding increased level of risk this brings to security of supplies and the impact this will have on consumers, including vulnerable customers. We are proposing for our southern network to replace 4% of its population and 3% in our Scotland network. This will target the highest risk sites while taking consideration of the level of uncertainty around the future role of the gas networks and in the decarbonisation of the energy system. Once more certainty is known, these volumes will require to be reviewed.

Price Control Deliverables

The below table shows the areas of work which are not a NARMs output and are therefore a price control deliverable. Each of these projects or programmes of work is detailed in the named projects/programmes annex at the back of this document.

Table 13: Price Control Deliverables

Asset Group	Unit	Scotland	Southern	SGN
Below Ground Governor Security	No. of installations	N/A	114	114
Governor Asbestos Management	No. of installations	429	2,682	3,111
Network Valves	No. of valves	682	1,020	1,702
Cathodic Protection	No. of schemes	1,251	836	2,087
IP Marker Posts	No. of posts	500	1,400	1,900
Nitrogen Sleeves	No. of sleeves	N/A	19	19
Gas Profilers and Logger Systems (PMAC)	No. of loggers	5,745	14,395	20,140
Model Validation Loggers	No. of loggers	4,591	6,250	10,841
Solar PV	No. of installations	900	1,500	2,400
Remote Pressure Management	No. of systems	N/A	702	702
Crossings <i>(4 named projects 2 of which are in Repex Appendix)</i>	No. of crossings	1	3	4
Includes – Temple Tunnel; Shalford Pipe Bridge; Cams Hall Tunnel (Repex); Kingsferry Bridge (Repex)				

6.3 Bespoke Outputs

The only bespoke output associate with this appendix is the project for installation of solar PV on governor installations. This is an uncertainty and is further detailed under the renewable energy deployment uncertainty mechanism.

6.4 Investment in Existing Assets – CBAs NARMs

Recent work with Ofgem has seen the NOMs being replaced with Network Asset Risk Measures (NARMs). The table below sets out the monetised risk at the start of GD1 and the delta to be achieved by the end of GD1 for governor assets.

Table 14: Governors Monetised Risk

Governors	2013	2021 without intervention	2021 with intervention	Delta (change in risk)
Southern Network	£8.590m	£9.696m	£9.552m	£0.144m
Scotland Network	£3.050m	£3.230m	£3.158m	£0.072m

Table 10 in section 6.2 sets out the equivalent change in risk over the 5 year GD2 period.

Much of the workload proposed in this appendix is on non-NARMS assets and as such is detailed as a PCD, all supported with an Engineering Justification Paper and a CBA. The approach to CBAs takes a similar methodology to that set out in NARMS, where we look at what ongoing costs may be incurred to assets on an ongoing basis if we 'do nothing' and based on the potential options for intervention set out in our 4 R's strategy, which of these costs can be avoided or reduced. This allows us to decide the best and most cost-effective solution for each asset group and associated investments. A summary of the CBA payback period is detailed in table 15 and 16 below in section 6.5.

6.5 Engineering Justification Papers

Governors – EJPs & CBAs

The governor business plan appendix is supported with 17 engineering justification papers (EJPs) and cost benefit analysis assessments (CBAs). These documents support our GD2 submission with detailed engineering Justifications and costs for both individual named projects and packages of governor investment programme of works detailed in this document. Table 15 details the governor EJPs and CBAs that support this business plan appendix. A summary of each of these projects and programmes can be found in Section 10.

Table 15: Asset Health Engineering Justification Papers (EJPs) & CBAs

Network	Project/Programme	Capex Value (£m)	NPV (£m)	CBA Payback (years)	Engineering Justification Paper - Reference
Scotland	ERS Replacement	£1.81m	41.81	4	SGN GOV - 001 ERS Repl Sc - EJP Dec19
	I&C Governor Replacement	£0.42m	0.93	9	SGN GOV - 002 I&C Repl Sc – EJP Dec19
	MP Governor Replacement	£4.14m	28.07	8	SGN GOV - 003 MP Repl Sc – EJP Dec19
	Service Governor Replacement	£0.50m	-0.07	37	SGN GOV – 004 Serv Repl Sc – EJP Dec19
	Governor Abandonment	£0.12m	1.94	5	SGN GOV – 005 Aband Gov Sc – EJP Dec19
	Governor Named Projects	£5.65m	0.08	29	SGN GOV – 006 Named Proj Sc – EJP Dec19
	Governor Refurbishment	£1.16m	55.39	3	SGN GOV – 007 Refurb Sc – EJP Dec19
	Asbestos Management	£0.29m	0.28	14	SGN GOV – 008 Asbes Man Sc – EJP Dec19
Southern	ERS Replacement	£11.43m	221.77	5	SGN GOV - 001 ERS Repl So - EJP Dec19
	I&C Governor Replacement	£0.34m	0.94	8	SGN GOV - 002 I&C Repl So – EJP Dec19
	MP Governor Replacement	£11.27m	86.72	8	SGN GOV - 003 MP Repl So – EJP Dec19
	Service Governor Replacement	£2.07m	0.39	29	SGN GOV – 004 Serv Repl So – EJP Dec19
	Governor Abandonment	£0.26m	4.89	5	SGN GOV – 005 Aband Gov So – EJP Dec19
	Governor Named Projects	£8.37m	48.09	10	SGN GOV – 006 Named Proj So – EJP Dec19
	Governor Refurbishment	£1.10m	58.81	2	SGN GOV – 007 Refurb So – EJP Dec19
	Asbestos Management	£1.71m	0.83	19	SGN GOV – 008 Asbes Man So – EJP Dec19
	Below Ground Governor Security	£6.85m	6.2	14	SGN GOV – 009 Sec Bel Gro So – EJP Dec19
Total		£57.49m	£557.07		

Integrity – EJPs & CBAs

The integrity business plan is supported by 18 engineering justification papers (EJPs) and cost benefit analysis assessments (CBAs). The table below details the Integrity Projects EJPs and CBAs that support this business plan appendix. A summary of each of these projects and programmes can be found in Section 10.

Table 16: Integrity Projects Engineering Justification Papers (EJPs) & CBAs

Network	Project/Programme	Value (£m)	NPV (£m)	CBA Payback (years)	Engineering Justification Paper - Reference
Scotland	Temple Tunnel	£0.11m	1.45	1	SGN Dint – 012 TempTun Sc - EJP Dec19
	Coastal Erosion	£0.72m	1.21	7	SGN Dint – 013 CoastEros Sc - EJP Dec19
	IP Marker Posts	£0.29m	0.23	12	SGN Dint – 014 IPMarker Sc - EJP Dec19
	Management of CP Systems	£1.44m	64.43	10	SGN Dint – 015 CathProt Sc - EJP Dec19
	Network Pressure Logger (PMAC)	£1.41m	3.72	9	SGN Dint – 016 ModProLog Sc - EJP Dec19
	Model Validation Loggers (New & Batteries)	£0.72m	12.3	13	SGN Dint – 017 ModValLog Sc - EJP Dec19
	Network Valve Remediation (Incl I&C)	£2.16m	1.52	13	SGN Dint – 018 NetVal Sc - EJP Dec19
	Renewable Network Maintenance Pressure Loggers	£1.30m	3.16	2	SGN Dint – 019 SolPV Sc - EJP Dec19
Southern	Shalford Pipe Bridge	£1.55m	22.88	1	SGN Dint - 001 ShalBrid So - EJP Dec19
	Coastal Erosion	£0.68m	1.27	7	SGN Dint – 002 CoastEros So - EJP Dec19
	IP Marker Posts	£0.82m	0.28	18	SGN Dint – 003 IPMarker So - EJP Dec19
	Management of CP Systems	£2.74m	204.1	10	SGN Dint – 004 CathProt So - EJP Dec19
	Nitrogen Sleeves	£1.51m	0.57	19	SGN Dint – 005 NitrSlev So - EJP Dec19
	Network Pressure Logger (PMAC)	£2.51m	0.79	28	SGN Dint – 006 ModProLog So - EJP Dec19
	Model Validation Loggers (New & Batteries)	£0.93m	18.93	13	SGN Dint – 007 ModValLog So - EJP Dec19
	Network Valve Remediation (Incl I&C)	£3.17m	2.32	13	SGN Dint – 008 NetVal So - EJP Dec19
	Renewable Network Maintenance Pressure Loggers	£2.05m	5.52	1	SGN Dint – 009 SolPV So - EJP Dec19
	Remote Pressure Management South London LP Pressure Loggers	£1.55m	4.03	6	SGN Dint – 010 RemMonLon So - EJP Dec19
	Remote Pressure Management Southern LP Networks Pressure Loggers	£1.84m	4.41	5	SGN Dint – 011 RemMonSouth So - EJP Dec19
Total		£27.5m	£353.12m		

6.6 Investment in New Assets

We do not anticipate any of the investment in new assets to be proposed within this appendix. They will be detailed in the Capacity Management appendix (018) or Connections appendix (020).

6.7 Cost Efficiency

Costs associated with this business plan appendix are made up of direct and contract labour, materials and reinstatement costs (usually based on contract tender rates). As each site is unique, an average unit rate has been estimated based on several likely work scenarios. The unit rate is affected by the size of the governor etc. and its location relative to suppliers.

Confidence in the costings associated with this work is high because of the quantities of equipment being replaced. Some sites will cost more, and others will cost less and allowing for unexpected site conditions, it would be prudent to rank confidence in the cost estimates as high.

This confidence rating is based on the average costing of the projects, site visits, CM/4 surveys, experience of similar works and dialogue, with the costing being agreed between the SGN Maintenance Manager and the Asset Engineering Manager.

It is important to consider that there will be differences on costs regionally, for example where we operate in remote areas of the Scotland network, but also in areas such as London and other areas in the southern network where higher labour costs may be expected or higher costs for street works and lane closures etc. However, we aim to manage local cost issues and efficiencies through an effective performance management strategy and regular financial reviews between asset and operations managers that review performance against allowances and budgets.

We have employed our 4 Rs strategy across all workloads covered within the proposal and created a CBA for each of those to demonstrate that we are proposing the optimal solution that is best for the network as well as ensuring it is a cost-efficient decision for the customer. Additionally, we are continuing to explore and implement the use of innovative techniques and equipment leading to costs savings as detailed in section 5.2 of this appendix.

Further detail on how cost efficiencies will be created particularly through contractor competition strategy can be found detailed in section 6.9 of this appendix or in the Cost Efficiency appendix (005).

6.8 Managing Uncertainty – ‘Use it or Lose it’ – Volume drivers

Given the uncertainties surrounding climate change and the impact of extreme weather events on the existing asset base we have proposed risk mitigation measures in response to immediate risk of asset failure due to fluvial and pluvial flood risk. We anticipated that this would be similar to the volume driver already in place with National Grid UK Transmission for their GT1, known as the ‘Quarry and Loss’ re-opener.

Uncertainty Mechanism: Environmental Resilience Reopener

To date we have witnessed seven occasions where our pipelines have been exposed due to land erosion where the location, speed and timing could not have been foreseen. We anticipate that in GD2 that these instances will become more frequent and could become more challenging as the pace of climatic change accelerates. This is a proposal that we also refer to in the transmission networks Transmission Integrity and Compliance appendix (021) where the network is faced with similar challenges and we provide an example of the Burn of Tynet.

It is this rate of change and the unknown location of the impact that makes environmental change so challenging to predict in terms of its impact and implications and from our perspective makes it appropriate for an uncertainty mechanism. To date most of the examples have been based in Scotland and we assume that this is likely to continue through GD2, however flood risk is increasing across the UK and we can anticipate that incidents will occur in southern.

Uncertainty Mechanism: Renewable Energy Deployment

Within the Environmental Action Plan (EAP) (003) we are proposing installation of solar PV across our maintained sites. However, these sites have not yet been subject to a detailed site survey as and such we have some uncertainty about whether the sites will be appropriate for deploying PV or whether there will be structural considerations that will limit the deployment.

Uncertainty Mechanism: Heat Policy Reopener

With the current level of uncertainty around the long-term role of gas networks and the decarbonisation of

the energy system, we have employed a ‘no regrets’ strategy in developing our GD2 Integrity and Governor programmes. Once clarity is known around these areas in GD2, it may be necessary to review the workloads and allowances in specific areas. This reopener mechanism will ensure customers are protected from higher potential charges until more certainty is known around the future role of the gas networks and the timing of replacement or decommissioning of these assets while maintaining safety and keeping the gas within the pipes.

Further details of these uncertainty mechanisms can be found in the Business Plan, Chapter 12.

6.9 Competition-Contracting Strategy

SGN comply fully with EU procurement legislation. Our Procurement and Commercial departments following business best practice, have developed a robust procurement strategy for both Integrity and Governors to address our medium and long-term requirements through collaboration with SGN Asset Management, Maintenance and Policy departments. The strategy has considered historical usage, current ways of working for the proposed GD2 outputs. Furthermore, we have also assessed how to encourage competition within the marketplace and promote innovation.

The Invitation to Tender for the supply and delivery of distribution governors will shortly be published in the “European Journal” and will capture the full requirements of the Scotland and Southern Networks. The tender will be conducted in-line with The Utilities Contracts Regulations 2016 and will follow the Negotiated Route. This will ensure compliance with the European procurement regulations and capture the principles of equal treatment of tenderers and transparency. The result of the said process shall be a multi-supplier framework agreement with up to five suppliers being awarded. The contract shall be in place for the last the last year of GD1 and the entirety of GD2. A framework agreement will provide numerous benefits including:

- Competition between suppliers
- Capped pricing
- Opportunities to “mini competition” to allow suppliers to compete for packages
- Agreed Terms and Conditions
- Quick ordering process due to pricing / terms being agreed upfront
- Opportunities to promote innovation through supplier management
- Opportunity for multiple suppliers to gain the required approvals to provide governors to SGN, such as under SGN management procedure SGN/PM/G/23 (Management Procedure for the Approval of New Products, Equipment and Techniques)

With GD2 and beyond in mind we are currently trialling two governors manufactured by Oxford Flow through the Network Innovation Allowance. These prototypes are the first virtually maintenance-free governors. This means there is potential for a significant decrease in maintenance costs over their lifespan. Trials are ongoing; however initial results are positive and suggest that they may perform better than traditionally designed governors.

Installation works for governors are currently conducted in-house or via a separate works framework agreement. Through the works framework we can achieve more competitive pricing due to being able to aggregate installation with other works required throughout the networks. Because of the aggregation of demand the suppliers on that framework are both top five by spend; however only a small portion is on governor installation.

Integrity innovation in GD1 has delivered in respect of maintenance of **Commercial Confidentiality**, we are currently negotiating a framework agreement with a supplier for their bespoke scanning services to inspect the modules. The technology has been developed through the Network Innovation Allowance and will shortly

begin to be implemented by our maintenance teams to capture any Orpheus units with non-compliant CP. This innovation device is a 3D corrosion mapping system that assists SGN engineers to assess and monitor defects it has found on a buried vessel, without any excavations. This technology has significant cost savings per inspection as well as greatly reduce SGNs carbon footprint with the no dig technique.

6.10 Real Price Effects

Our GD2 forecasts do not include any anticipated real price effects.

Ofgem has determined that the GD2 price control will use CPIH as the measure of inflation through which allowances should be adjusted year on year. While we consider CPIH to be a reasonable indicator of overall prices, SGN's labour costs typically tend to exceed this index. As such, we have experienced real price effects in excess of those which would be applied through CPIH. We discuss this further, and propose alternative indices, in our Cost Efficiency appendix (005).

The costs in this appendix are predominantly based on existing programmes and procurement events where there is good historical evidence to support the costs put forward. However, it has also been considered that labour and materials may be subject to cost pressures and this has been documented as part of the risk register on the CBA for each project or programme where appropriate.

Table 17: Scotland Cost Assessment

Scotland	Description	Output	Workload Numbers	Gross Unit Costs £k (*)	Total Gross Costs £m (**)
Crossing	Temple Tunnel	Remediate pipe and pipe supports in Tunnel	1	£110	£0.11m
	Total				£0.11
Protection	IP Marker Posts	Markers to protect against 3rd party damage	500	£0.6	£0.29m
	Management of CP Systems	Maintain and refurbish Cathodic protections system to enhance asset life	1251	£1.1	£1.4m
	Network Pressure Logger Replacement (PMAC)	Programme of replacement of loggers for system management	5,745	£0.24	£1.41m
	Coastal Erosion	Management of below ground coastal and river crossings.	5	£144	£0.72m
	Model Validation Loggers (New and Replacement)	Programme of replacement of loggers for Model validation	4,591	£0.157	£0.72m
	Renewable Network Maintenance Pressure Loggers	Programme to install solar PV panels	900	£1.4	£1.3m
	Total				£5.84
Valves	Network Valve Remediation	Remediation work to ensure that safety valves are accessible	682	£3.17	£2.16m
	Total				£2.16m
Governors	Full Replace	Expected replace of medium pressure, ERS governors and industrial & commercial governors	67	£181k	£12.142m

Refurbishment	Replace components weather damaged and non-compliant governor housing	519	£2.788k	£1.447m
Service Regulators	Replace failed IP and MP domestic service regulators	355	£1.414k	£0.502m
Total				£14.09m
Overall Total				£22.2

(*) Unit costs may be averaged or given a range according to the homogeneity of the projects

Table 18: Southern Cost Assessment

Southern	Description	Output	Workload Numbers	Gross Unit Costs £k (*)	Total Gross Costs £m (**)
Crossings	Shalford Pipe Bridge (Named project)	Repair and remediation of existing pipe at exposed crossing	1	£1186	£1.86m
Total					£1.86m
Protection	IP Marker Posts	Markers to protect against 3rd party damage	1,400	£0.6	£0.82m
	Management of CP Systems	Maintain and refurbish Cathodic protections system to enhance asset life.	836	£3.2	£2.74m
	Nitrogen sleeves	Replacement of nitrogen sleeve with grout	19	£80	£1.51m
	Network Pressure Logger Replacement (PMAC)	Programme of replacement of loggers for system management	14,395	£0.17	£2.51m
	Model Validation Loggers (New and Batteries)	Programme of replacement of loggers for Model validation	6,250	£0.14	£0.93m
	Renewable Network Maintenance Pressure Loggers	Programme to install solar PV panels	1,500	£1.4	£2.05m
	Remote Pressure Management South London LP Pressure Loggers	Installation of new pressure logger equipment	317	£4.89	£1.55m
	Remote Pressure Management Southern Network LP Pressure Loggers	Installation of new pressure logger equipment	385	£4.78	£1.84m
	Coastal Erosion	Management of below ground coastal and river crossings.	5	£136	£0.68m
Total					£14.63m
Valves	Network Valve Remediation	Remediation work to ensure that safety valves are accessible	1,020	£3.1	£3.17m
Total					£3.17m

Governors	Full Replace	Expected replace of medium pressure, ERS governors and industrial & commercial governors	195	£162k	£31.669m
	Refurbishment	Replace components weather damaged and non-compliant governor housing	2891	£3.341k	£2.809m
	Service Regulators	Replace failed IP and MP domestic service regulators	2595	£ 0.8k	£2.065m
	Below Ground Governor Security	Repair of covers in roadways to ensure safe environment	114	£60	£6.85m
	Total				£43.393m
Overall Total					£69.903m

(*) Unit costs may be averaged or given a range according to the homogeneity of the projects

6.11 Financial Summary

For the purposes of this business plan submission we have made our forecast on the basis that:

- all prices are expressed in 2018/19 values;
- cost pressures between 2018/19 and the start of the price control 2021/22 will be equal to CPIH for the majority of components apart from labour;
- all projects have been reviewed and assessed through NARMs and CBA methodologies where relevant to the asset group;
- on the basis of these assumptions we have set out both historical expenditure our forecast expenditure for RIIO-GD2. There will be regional prices difference between Scotland and Southern, this is due to the different geography, demographics and cost of living and labour;
- we propose a £1.66m gross investment in crossings;
- the investment of £13.78m gross in protection and data loggers;
- an environmental investment of £6.74m for installation of solar PV and remote pressure management;
- for valves we propose to invest £5.33m gross in GD2; and
- finally, for governors, governor refurbishment, below ground governor security, asbestos and service regulators we propose to invest £57.48m, as set out in Section 6.2.

The table below demonstrates the expenditure for Governors through GD1 thus far as well as the forecasted investment for the remainder of GD1 and throughout GD2. This information is shown in the Governor tab, 3.03 of the BPDT. The table also demonstrates the proposed investment for <7bar Asset Integrity related works throughout GD2. This information is contained within the Other Capex tab, 3.05 row 52 of the BPDT.

Table 19:RIIO-GD2 Investment proposal (£m 18/19 prices)

SGN (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.91	0.75	0.00	0.00	0.00
Protection									1.71	1.63	1.62	1.62	1.62
Data Loggers									1.16	1.11	1.10	1.10	1.11
Valves									1.11	1.06	1.05	1.05	1.06
Environmental									1.89	1.78	1.02	1.02	1.03
Governors									11.46	11.37	11.53	11.53	11.59
Governors & Integrity GD1	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44					
Total	9.05	20.26	11.08	9.14	11.20	15.44	14.14	13.44	18.25	17.70	16.33	16.32	16.41
Scotland (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.11	0.00	0.00	0.00	0.00
Protection									0.49	0.49	0.49	0.49	0.49
Data Loggers									0.43	0.43	0.43	0.42	0.43
Valves									0.43	0.43	0.43	0.43	0.43
Environmental									0.26	0.26	0.26	0.26	0.26
Governors									2.69	2.69	2.88	2.89	2.94
Governors & Integrity GD1	3.42	9.49	3.20	2.52	2.62	2.90	3.36	3.77					
Total	3.42	9.49	3.20	2.52	2.62	2.90	3.36	3.77	4.41	4.31	4.48	4.49	4.55
Southern (£m)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25	25/26
Crossings									0.80	0.75	0.00	0.00	0.00
Protection									1.22	1.14	1.13	1.13	1.13
Data Loggers									0.73	0.68	0.67	0.67	0.68
Valves									0.67	0.63	0.62	0.62	0.62
Environmental									1.63	1.52	0.76	0.76	0.77
Governors									8.77	8.67	8.65	8.64	8.65
Governors & Integrity GD1	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66					
Total	5.63	10.76	7.88	6.62	8.58	12.54	10.78	9.66	13.83	13.39	11.84	11.82	11.85

Hatched areas do not have directly comparable data for GD1 as it was not separately identified in this manner

6.12 Assurance

Our Business Plan, including Appendices, has been subject to a rigorous assurance process which is detailed in Chapter 3 of the Plan and the Board Assurance Statement.

Our Network Director was appointed as the Sponsor for the Distribution Integrity and Governors Appendix and the associated Cost Benefit Analyses (CBAs), Engineering Justification Papers (EJPs) and Business Plan Data Templates (BPDs); which have been through the following levels of review and assurance:

First Line

This was undertaken at project level by the team producing the document, as a self-check or peer review.

Second Line

This was undertaken independently within the organisation to review and feedback on product development, including a GD2 workshop on Capital Expenditure (CAPEX), CBAs and EJPs. Internal Audit reviewed the third line assurance work conducted by Ove Arup and Partners against scope.

Both Senior Manager and Director sign-off was obtained and our RIIO-GD2 Executive Committee: (1) considered the appropriateness of assurance activity for the Appendix and (2) provided assurance to SGN's Board that the Business Plan meets Ofgem's assurance requirements.

Third Line

This was undertaken by external advisors and groups providing critical challenge during the development of products within the Business Plan. In addition to the feedback and challenge provided by the Customer Engagement Group (CEG) and Customer Challenge Group (CCG) this Appendix was developed after consultation with and advice from:

Advisor / Group	Contribution
Ove Arup and Partners	Consultancy support to enable development of an evidence based high quality business plan draft by acting as an expert challenge group through independent peer reviews against Ofgem Business Plan Guidance.

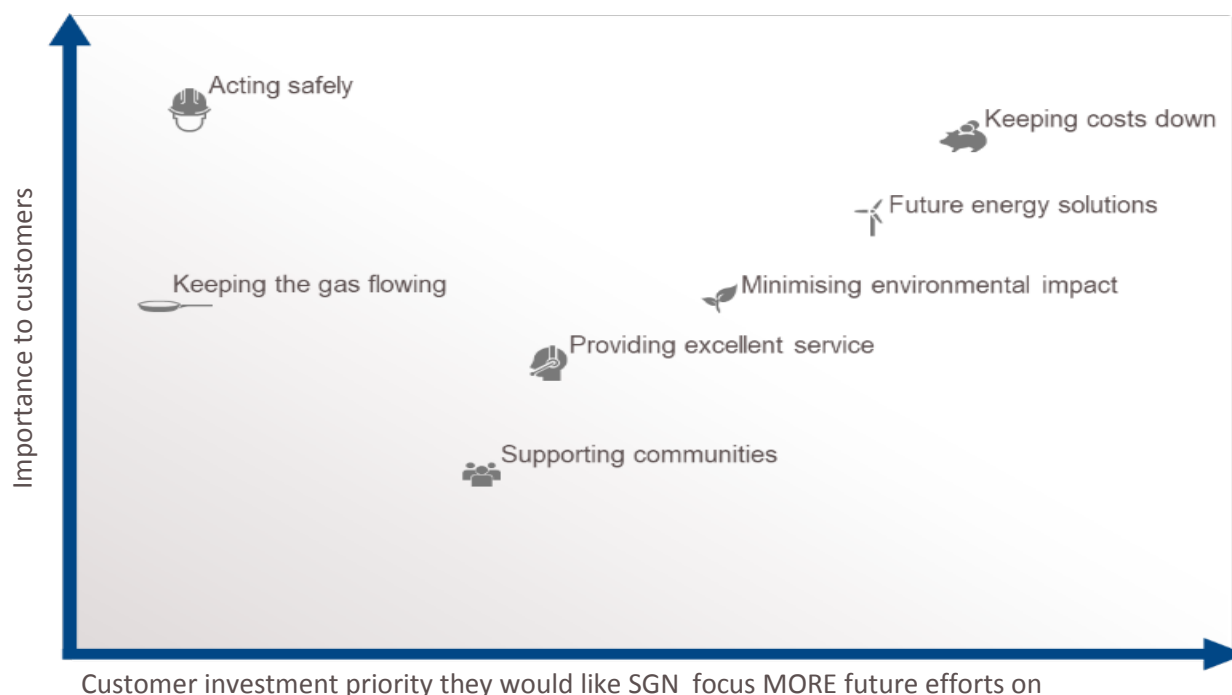
Fourth Line

This was undertaken by independent and impartial external providers, who provided a detailed and comprehensive report to both the Executive Committee and Board of Directors:

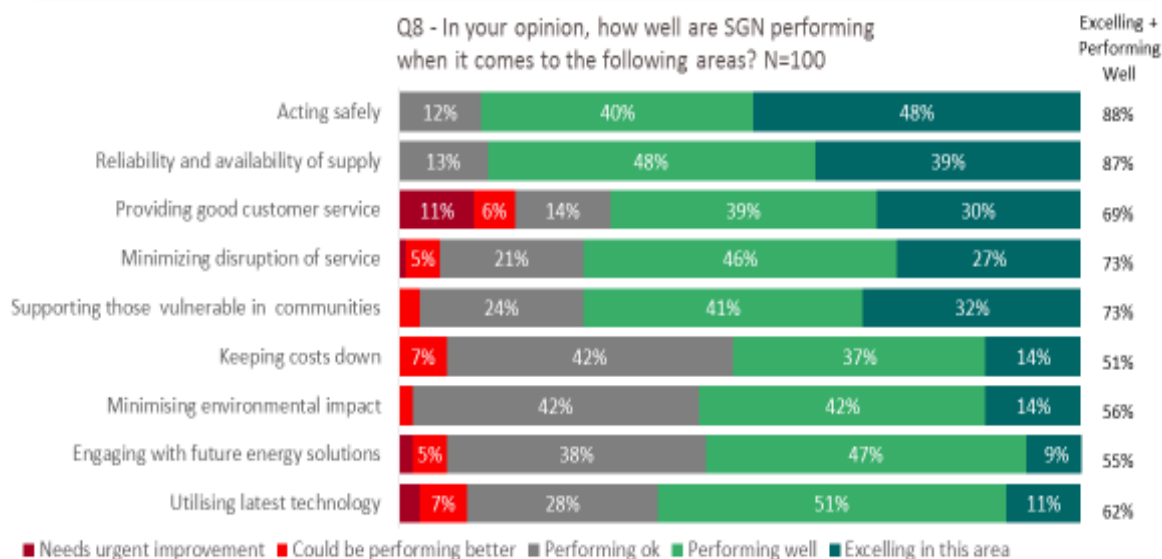
Advisor / Group	Contribution
Ove Arup and Partners ('Clean' Team)	Review of Appendix against Ofgem's assurance requirements.
PwC	Business Plan Data Template review: Reinforcement (<7 barg), Other Capex and Reliability

7 Stakeholder Annex

As described in section 4 above, our programme of customer research shows that customers view keeping costs down as their top priority. The results also demonstrate that whilst acting safely and keeping the gas flowing are of high importance, customers view our current level of performance as already very good and would therefore not want us to invest significantly in going beyond current levels of performance. These priorities have informed our strategy towards our distribution investment plans in GD2.

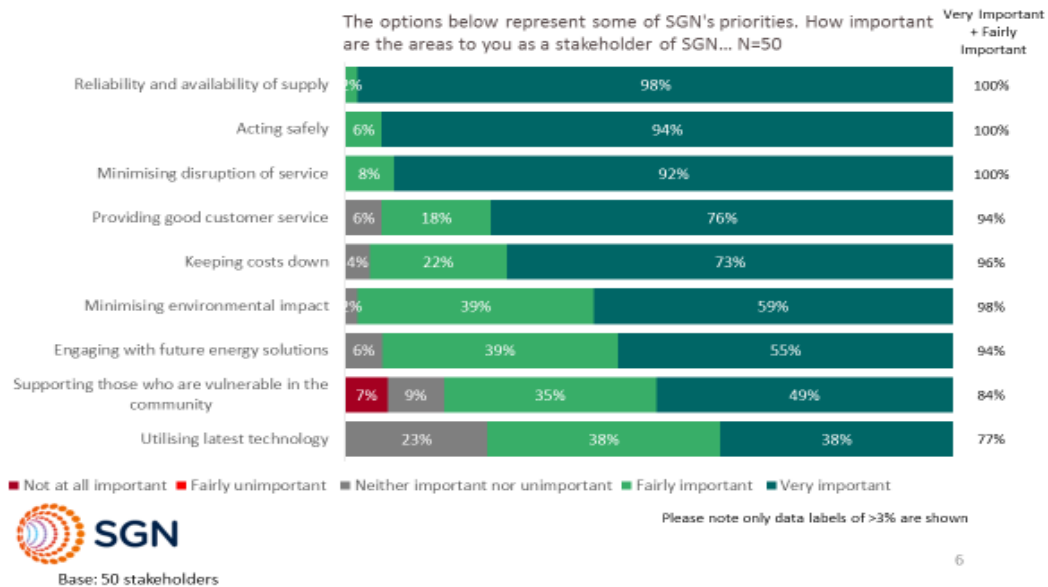


The prioritisation of safety and maintaining reliable gas supplies has also been identified by our stakeholders in our engagement and research. This has been demonstrated by our stakeholder satisfaction surveys where in a recent survey 97% of stakeholders rated these two areas as fairly or very important. 87% of stakeholders felt we were performing well or excelling in relation to acting safely and reliability and availability of supply. None felt we could be performing better or needed to urgently improve.



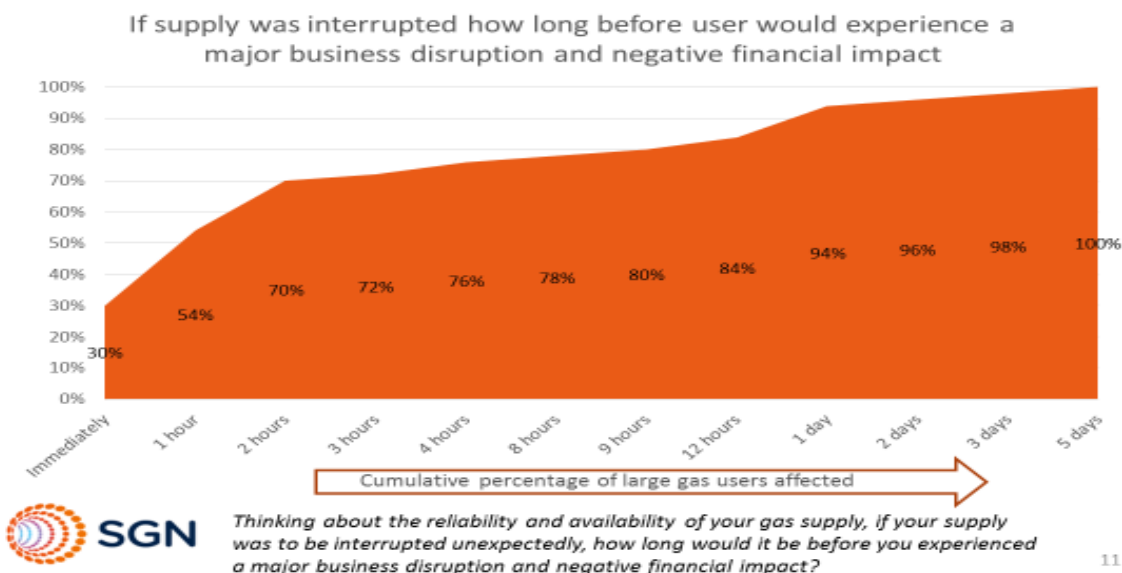
We conducted a survey with 50 of the largest gas users connected to our network. 100% of respondents viewed reliability and safety as important, and all felt we were performing well against these priorities.

In the large gas user survey: same areas in top 4 (i.e. safety, reliability, minimising disruption & service) but different ranking. Also only one area was rated as unimportant



Large gas users clearly indicated that interruptions in gas supplies has a large impact on their businesses, which increases in severity over time.

7 in 10 large gas users would experience a major business disruption and negative financial within 2 hours of their supply being interrupted unexpectedly



In our programme of customer research, customers were specifically asked to rank attributes relating to different topics. Our customers strongly rated ensuring gas supplies are reliable as the most important priority. There was broad and high agreement that SGN need to maintain consistent supply. This priority was ranked highest by customers when we looked at this on a regional basis across Scotland, London and in the South East.

Customers are happy with the current services they receive and very few have experienced issues. They believe we should be ensuring maintenance of the gas infrastructure continues. For hard to reach groups, reliability of supply was seen as essential, and the need for consistent supply that enabled heating, meant that this outweighed 'keeping costs down'.

At our Moving Forward Together workshops in November 2018 we asked stakeholders for views on improving resilience, security and safety. This included a conversation with stakeholders to better understand if they supported relocating vulnerable or pipeline high-risk assets, and 'twinning' gas supplies to improve resilience in areas that are currently reliant on a single gas feed. Improving resilience of some major towns and cities that are 'single fed' by twinning these pipelines was seen as something to consider based on an evaluation of risk of potential loss. To justify an increase in investment in this area, customers want us to assess the risk in terms of likelihood and consequences of failure. More informed stakeholders have also questioned why gas critical infrastructure is not funded in the same way and to the same extent as the water industry, and there were views expressed that water, electricity and gas should all be treated in the same way.

Making our network more resilient

Keeping the gas flowing

Parts of our network are less resilient than others.

1 Some of our high-pressure pipelines supplying major towns and cities are 'single-fed', meaning there is no alternative means to transport gas if these pipelines fail. We could invest in 'twinning' these pipelines for additional resilience.
Who pays: Future bill payers

2 Sometimes installations supplying critical sites like hospitals and prisons have only one gas feed. We could invest in improving the resilience of supplies to selected critical sites by ensuring these locations have back-up measures in place to keep the gas flowing in the event of an unforeseen issue with the primary supply.
Who pays: Future bill payers

3 In some areas, our pipes are found on bridge crossings, near rivers and in areas that are more likely to flood. These pipes are more at risk of being damaged as a result of things like flooding, being struck by objects, or interference by trespassers. We could remove or relocate some of these pipes to significantly reduce the likelihood that they will cause any harm or fail as a result of damage.
Who pays: Future bill payers

Q. What are your thoughts on these options?

Q. Is there anything you'd like to see that hasn't been mentioned?

Stakeholders suggested that removal of vulnerable assets seemed to be a sensible option. Other stakeholders expressed the view that this activity sounded like it would be expensive, so they would expect SGN as the engineering experts to make a reasonable decision as to whether this was necessary based on the potential risks involved and consequences of failure.

Through our programme of customer research, we asked customers what initiatives and improvements they would be willing to pay for. In our first wave of willingness to pay customers were asked to what extent they supported relocating pipes to reduce the risk of damage (an extra 30p per year on their gas bill). 83% of respondents were supportive of this option, with 5% of the remaining 17% strongly opposed to it.

In addition, customers were given an opportunity at our business plan acceptability testing workshops to prioritise additional investment in assets where we see changes in risk failure due to environmental changes. In the quantitative phase of our customer acceptability testing customers were also asked a question in relation to improving the reliability and safety of gas pipe. Customers exhibited high levels of acceptability for

our proposals to enhance the reliability and safety of gas pipes, for example by removing steel tails from gas services, removing redundant pipework and doing more inspections of medium-rise block of flats. This additional element attracted the highest acceptability levels of all the options tested in this phase of research, scoring 85% in total for southern customers and 89% in total for customers in Scotland.

In relation to improving physical security, stakeholders shared similar views to the conversation relating to a more resilient network. Stakeholders suggested that the level of investment should reflect the criticality of the site and consequence of it failing.

Improving security


Keeping the gas
flowing

Ensuring that our networks are resilient to both cyber and physical security threats is essential for both safety and reliability, especially as more of our distribution assets start to make use of new technologies to become 'smart'.

Cyber security

We could invest in enhanced cyber security systems over-and-above the minimum guidance levels required for operational security to ensure we are at the forefront of industry best practice.

Who pays: **Current bill payers**



Physical security

As threats to national infrastructure intensify, we could invest in further physical security measures at our sites to make them more resilient, targeting:

- A.** Larger offtakes/pressure reducing sites (dozens of locations)
- B.** Most pressure reducing sites (hundreds of locations)
- C.** Strategic district governors (thousands of locations)

Who pays: **Future bill payers**

Q. What are your thoughts on these options?

Q. Is there anything else you'd like to see us doing?

Our 'willingness to pay' customer research asked customers to what extent they supported enhancing security to prevent physical attacks (an extra 46p per year on their gas bill). 82% of respondents were supportive of this option, with 5% of the remaining 18% strongly opposed to it.

Our stakeholder engagement has shown that engaging with future energy solutions and utilising latest technology is viewed as important to most stakeholders. A key recommendation that arose from our Sustainability roundtable events, held with expert stakeholders in the field of sustainability, was that we should invest in our network to accommodate more low carbon gas.

Stakeholders at our Moving Forward Together workshops in March 2018 participated in discussions on:



**Creating a low maintenance, smart network AND
Extending the network in our footprint**

A



**Driving operational excellence with innovation and technology AND
Automating our support processes**

B

At our Moving Forward Together workshops in November 2018, we continued the conversation, asking stakeholders about greater application of smart technology across our network.

Creating a 'smarter' network

Keeping the gas
flowing

Greater application of 'smart' technology across our network will help us to create a low maintenance network that is flexible and fit for the future. Examples include more accurate meters at large 'offtake' sites (which measure gas flows and quality) and remotely operable tools to monitor and control flows of gas through our network of pipes and governors.

This would help:

- Improve our ability for our engineers to identify any potential emerging issues early and respond to changes in gas demand more accurately, making supplies more reliable.
- Improve our environmental performance, as better control over pressures in gas networks will reduce the amount of gas lost through leakage. It would also mean that we'd need to send fewer engineers into the field, so we'll be driving less which would further reduce carbon emissions.

Who pays: **Future bill payers**

Q. What are your thoughts on this option?

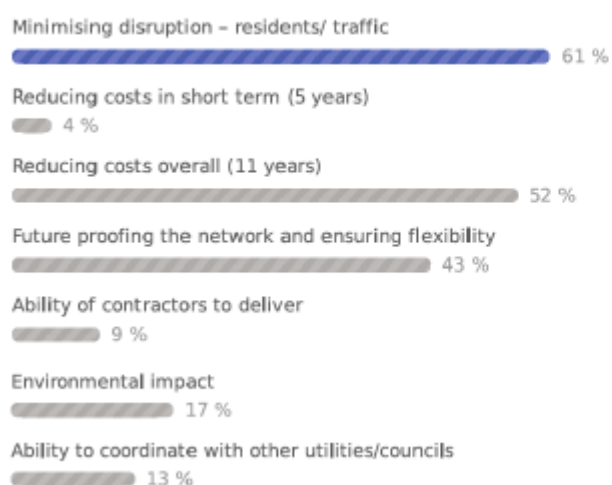
Q. Is there anything else you'd like to see us doing?



There was broad from stakeholders that smart networks should be included in future business plans. Remote network control for critical national infrastructure sites was also considered important and of value. Stakeholders expected us to be clear on what the pay-back periods and benefits of smart technologies such as remote pressure control would be.

At our Moving Forward Together workshops in January and February 2019, we asked stakeholders to consider the criteria they would apply when making investment decisions in our network. They were then asked, of those criteria, which were most and least important:

Poll: Please choose the two criteria you think are most important
(23 respondents)





Stakeholders viewed future-proofing the network and ensuring flexibility as the second and third most important criteria in Scotland and London respectively, and was seen as one of the least important factors by no more than only 5% of stakeholders at either of the workshops.

In our quantitative acceptability testing customers were asked a question in relation to the additional element of encouraging more low carbon 'green gas' into the network. This additional element of our plan attracted fairly high total levels of acceptability from both customers in Scotland and southern, at 77% in southern and 81% in Scotland. Domestic customers in Scotland gave this element the highest acceptability (81%), Scotland SME business customers gave this the lowest acceptability (78%).

The results of our first wave of customer willingness to pay testing indicated customers are prepared to pay £3.36 for additional investment to enable 20% of green gases to be carried in our network.

8 Result of Over Pressurisation of Gas Networks

Over Pressurisation Occurred 2018

We require GD2 funding to allow it to continue to replace its ageing and non-compliant distribution governors. This governor replacement programme will be on a risk-based approach. We cannot allow distribution governors to fail. Industry standards and all our maintenance policies and procedures are designed to prevent an over-pressurisation of the lower pressure gas mains networks. An over-pressurisation of a network would have disastrous effect to customers properties and their residents.

The following paragraph is a recent summary of event where a governor failed open causing a fatality and damaging 131 buildings, but it could have resulted in many more fatalities and property damage. Due to safe engineering practices, fortunately these types of events are infrequent.

On September 13, 2018, about 4:00 p.m., a series of explosions and fires occurred after high pressure natural gas was released into a low-pressure gas distribution system in the northeast region of the Merrimack Valley in the state of Massachusetts. The distribution system was owned and operated by Columbia Gas of Massachusetts, a subsidiary of NiSource. The system over-pressurisation damaged 131 structures, including at least 5 homes that were destroyed in the city of Lawrence and the towns of Andover and North Andover. Most of the damage was a result of structure fires ignited by gas-fuelled appliances. Several structures were destroyed by natural gas explosions. One person was killed and at least 21 individuals, including 2 firefighters, were transported to the hospital. Seven other firefighters received minor injuries.

Figure 18: Aerial views of 2 homes impacted by the over-pressurisation incident in Massachusetts. The event caused significant fire damage (Left) and a fatality after a chimney collapsed on a vehicle parked in the driveway (Right).



Over Pressurisation Occurred 1983

The following paragraph is an event that occurred in 1983 where a governor failed open causing 6 fatality and severely damaging a hotel, but it could have resulted in many more fatalities. After an engineering assessment the hotel had to be totally demolished due to the structural damage caused by the explosion.

In 1983, a Distribution Governor owned by Scottish Gas - the Network owner at that time - failed open and over-pressurised a low-pressure commercial service. This gas supply was feeding into the Royal Darroch hotel in Cults, Aberdeenshire. The resulting explosion caused the deaths of six guests and 18 people were injured, some critically. The 3-story building was destroyed by a gas explosion at 08:45am whilst breakfast was being served in the hotel. The disaster could have been much worse as the hotel was mostly empty and the majority of guests had already checked out and left the premises earlier that morning. Again, due to safe engineering practices, fortunately these types of events are infrequent.

Figure 19: Aerial view of the Royal Darroch Hotel from 1983. The building was demolished due to extensive structural damage.



9 Glossary

All acronyms and associated descriptions can be found within the Glossary Appendix.

Annex redacted