

RIIO GD1 Network Output Measures (Monetised Risk) – Rebaselining Methodology

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Version History

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1. Introduction

As part of the current regulatory framework under GD1, the regulator, Ofgem, moved to a more incentive orientated approach to regulation of gas distribution networks based on a suite of outputs. As part of a group of reliability based outputs, a secondary deliverable known as 'Network Output Measures' (NOMs) was agreed. This output is defined within Special Condition 4G and the associated arrangements for incentive and penalty are defined within Special Condition 4H.

NOMs incorporate two outputs: asset health, criticality and risk (HCR) and capacity utilisation. The capacity utilisation measure has been fully defined and reports have been submitted as part of the RRP for each year of RIIO; this document therefore relates to the asset health, criticality and risk measure.

Initially and in preparation for the introduction of the RIIO framework, the HCR output was perceived as a suite of indices: HI1 to HI5 for asset health, CI1 to CI4 for criticality and RI1 to RI5 for asset risk. In 2010 the regulator directed the Gas Distribution Networks (GDNs) to develop their own methodologies for the compilation of these indices. Due to the different nature of the asset groups forming a gas distribution network, the methodologies for each asset group would inevitably differ both in terms of health and criticality and the indices were never likely to be comparable across asset groups.

SGN duly developed methodologies for each asset group. In some cases, such as the methodology for Offtakes and Pressure Reducing Stations, external consultants were employed. Immediately prior to the publication of Final Proposals, Ofgem requested the GDNs to consider the development of a single consistent methodology for use by all GDNs. However, this could not be achieved prior to the commencement of GD1 and, therefore, each GDN submitted Workbooks containing targets for the HCR output against their own methodologies. These targets were as follows:

- Position as at 1st April 2013
- Position as at 31st March 2017 without intervention
- Position as at 31st March 2017 with intervention
- Position as at 31st March 2021 without intervention
- Position as at 31st March 2021 with intervention

The submissions covered 47 asset groups, which were intended to cover all operational gas assets.

The regulator provided Final Proposals to the GDNs on 17th December 2012 and revised versions of the Network Asset Workbooks (NAW) were submitted taking into account any changes in workloads that were agreed. SGN's submissions were dated 18th January 2013 and provided the final agreed performance targets for this output.

The Safety and Reliability Working Group (SRWG) was formally convened in 2013 comprising representatives from the GDNs and in 2014 work commenced on developing a new methodology that expressed health as a function of reliability (failures per annum), criticality as a function of monetary consequence (and the likelihood of that consequence occurring) and risk as a product of these factors; thus monetised risk was derived. Since the risk for all asset group is expressed in a common unit (£), some comparison is possible for all reported asset groups. Also, this allows some evaluation of what is called Risk Trading, that is, investment in an alternative asset group other than what was planned as part of the Business Plan submission.

As part of the 2017 RRP SGN is obliged to provide a resubmission of the targets contained within the original Workbooks in accordance with the MR methodology as follows:

- Position as at the start of RIIO GD1, namely 1st April 2013

- Position at the end of RIIO GD1, namely 31st March 2021, without intervention
- Position at the end of RIIO GD1 with intervention

It must be noted that the basis upon which the original health and criticality indices were calculated is markedly different from that used for monetised risk. Factors such as condition and obsolescence are still applied, although other factors such as specific failure modes, extent of environmental impact including carbon impact are new, which means that the indices based output is not directly convertible into Monetised Risk. As a result, it has been necessary to return to first principles (for example, recreation of the asset base as at 2013, collection or approximation of fault rates prevalent in 2013, re-application of the interventions agreed at Final Proposals) in order to derive values of Monetised Risk for relevant assets.

Special Condition 4H requires that any rebaselining of this methodology should be:

- Consistent with Final Proposals
- Remain equally as challenging as those set out in the original Workbooks

In all cases, Excel based MRS models, which were built by the consultant, DNV GL, specifically for the purposes of deriving Monetised Risk, will be used for the calculation of outputs. Version control of the MRS models is managed directly by the SRWG. The models used, their version numbers and any factors and algorithms used within the models will be verified with the SRWG and the relevant validation sub-groups.

This document serves to build upon the generic 'Rebasing Methodologies' report submitted to the Regulator by the SRWG and details the specific rebaselining methodologies applied by the company in compiling Monetised Risk outputs.

In all cases, SGN has attempted to recreate the asset base for each relevant asset group as at 2013 using information available from our data repositories. Where data gathering or correction has improved our knowledge of the asset base during GD1, this learning has been used to define the applicable base data.

In many cases, relevant fault data dating back to 2013 is available and this has been used to calculate fault rates. Where such information is not available or, due to the integrity of the asset, is low in volume or unreliable, the outcome of either expert elicitation undertaken on behalf of the SRWG or industry wide studies has been used.

The following criteria has been applied within the rebaselining methodology for Monetised Risk within SGN:

- The Excel based MRS models provide an option for cohorting of assets into groups. Indeed, cohorting of some asset groups is necessary due to a limit in the number of lines of data possible within a single Excel model. Where possible, SGN has applied cohorting on a similar basis to that used within the original workbooks. For example, no cohorting has been applied to Offtakes and Pressure Reduction Stations (PRS), while services and service governors have been widely cohorted. One exception is the treatment of governors, where cohorting was applied by governor type in the original workbook, but assets have been itemised within Monetised Risk. By itemising governors individually, this provides greater detail and accuracy and is therefore considered to be beneficial.
- SGN has applied the interventions as detailed within our Business Plan and as amended in terms of work volumes and work type by the agreed Final Proposals. For example, SGN requested funding to replace a number of district governors during GD1. However, with certain exceptions, SGN accepted a reduction in overall workload volumes and the regulator provided funding to replace only 50% of the agreed volume and further funding to refurbish the remainder. SGN has not attempted to derive alternative interventions to those agreed with the regulator in Final Proposals.

- The original workbooks included only integrity based interventions on the understanding that the output was engineering to monitor the reliability (health) of the assets. As such, growth was not generally included, not least because the volume of work is not driven by the GDN and therefore not easily accountable under an output. The exception was that two local transmission system reinforcement schemes were included within the Integrity Business Plan for Scotland network, namely Foudland / Moray and Logeirait, the former related to the removal of interruptible contracts in 2016 as a result of a modification of the Uniform Network Code, Mod90. There are also a number of PRS rebuilds itemised within the LTS plan that were justified on the basis of integrity and these have also been included in the latest workbooks.
- Due to limitations of the model, only ten intervention types were permissible and only a single intervention can be applied to any asset over the life of GD1. In many cases, this did not pose a problem, but as detailed elsewhere work-arounds were required in isolated situations.

2. Establishing the rebaselined data set

2.1 General

The fundamental building block of the Monetised Risk methodology is to create a baseline position as at 1st April 2013, the start of RIIO GD1. To that end, the approach of SGN has been to recreate the base data set for each asset group as detailed below.

Once the baseline has been derived, at least two models for each asset group are produced:

- One model provides, firstly the baseline, known as the 'Without Intervention' option.
- This model also includes interventions in accordance with Final proposals. The model provides a 'Post Intervention' output, which represents the 'With Intervention' option.
- A second model containing the consistent baseline data is updated to include actual interventions undertaken within GD1. This model therefore provides the current or actual position. This model will be updated as interventions are completed.
- For LTS pipelines, the model was unable to properly model interventions such as diversions and reinforcements. As a result, multiple models were created modelling various elements of the system, upon which interventions were applied.

2.2 LTS Pipelines

LTS pipelines are deemed to be Major Accident Hazards under the Pipelines Safety Regulations and are subject to detailed reporting to the safety regulator, HSE. As such, SGN has an accurate record of the full asset base from 2013. This data set can therefore be used directly to provide the baseline position as at 1st April 2013. Similarly, any reinforcement, extension or diversion of an LTS pipeline is reportable and a full audit trail exists of all works allowing the asset base as at 1st April 2013 to be interpolated from the 2017 current position.

LTS pipelines are subject to the Pressure Systems Safety Regulations, 2000, (PSSR) and therefore require a Written Scheme of Examination (WSoE), which includes historic data covering modifications to the system. As such, the WSoE provides an additional audit trail allowing the asset data baseline to be validated.

The condition of LTS pipelines is also robustly captured as follows:

- A requirement of PSSR is that all faults are required to be graded, reported and rectified. All significant faults (A2) and those constituting immediate danger (A1) already form part of a separate output under RIIO and the information is robustly archived.
- Internal inspections of relevant pipelines (OLI/1) are captured under PSSR and defects are reported accordingly. Full condition reports are also available from the inspector, General Electric Pipeline Integrity International (GE PII) and these are robustly archived.
- External surveys are also undertaken on all pipelines (OLI/4), known as Close Interval Polarised Potential Surveys (CIPPS). For non-OLI/1 pipelines, these are also a requirement under PSSR. Results are recorded within the Pipelines Compliance System database (PCS) held by Maintenance and the information is fully archived.
- Data from cathodic protection surveys is also recorded within PCS and is fully archived. As such, data is available for 2013.

Data relating to damage on LTS pipelines and resultant product releases is scarce primarily because instances are very rare. GDN specific data would therefore not constitute a statistically viable sample. GDNs already pool such data with the UK Onshore Pipelines Association, UKOPA, which is

shared with European organisations, such as European Gas Pipelines Incident Data Group, EGIG. Pipeline Integrity Engineers, PIE, already administer this data on behalf of UK operators and, as part of the development of the MRS model for LTS pipelines, PIE developed common fault data, which has been used within the SGN model. This data provided failure rates dependant on age, diameter and wall thickness. By applying the known age of the pipelines as at 2013, the base data can be derived.

2.3 Mains

Asset data is held within the company's asset repository, Maximo and is graphically represented within MAPS. Maximo includes details of decommissioned assets and dates of modifications. On an annual basis, all replacement activity is audited prior to external regulatory reporting. Other systems such as permitry databases are used to validate dates, lengths and asset details of work undertaken. As such, an accurate data set as at 1st April 2013 is available.

Fault data is also held within Maximo and is itemised both by failure mode and repair type. In some cases, such fault data, such as mains fractures and gas in buildings is reported externally and is regularly validated. Full historic data is available back to 2013 and beyond.

The SRWG had agreed for the MRS model for distribution mains to use ten year weighted averages of failure rates taken directly from asset repositories to reduce the impact of variances within a given year, such as those due to weather, temperature. However, SGN have the benefit of the output from a Predictive Analytics (PA) model developed in conjunction with consultants Trinity Horne, who later formed part of Bearing Point. The PA model was developed in 2015 and took data from the previous seven years and used that to provide future forecasts. The data was weighted within the model putting emphasis on the last five years and data from years one and two shows evidence of issues associated with the adoption of the Maximo repository system.

2.4 Services

Service numbers are available within our core asset repository, Maximo, although the high numbers involved mean that there is a potential for a degree of error. As a result, total numbers have been verified using other available sources. SGN intend to undertake a validation of service numbers against Meter Point Reference Numbers, MPRN, when some confidence can be gained in the accuracy of that data set. For older services, there is an absence of data regarding material within the repository. As a result, some assumptions have been necessary in this regard.

Network wide service failure and replacement numbers are captured within Maximo allowing SGN specific data to be used within the model. The SRWG had agreed for the MRS model for services to use the weighted averages of failure rates taken directly from asset repositories to reduce the impact of variances within a given year, such as those due to weather, temperature. However, SGN have the benefit of the output from a Predictive Analytics (PA) model developed in conjunction with consultants Trinity Horne, who later formed part of Bearing Point. The PA model was developed in 2015 and took data from the previous seven years and used that to provide future forecasts. The data was weighted within the model putting emphasis on the last five years and data from years one and two shows evidence of issues associated with the adoption of the Maximo repository system.

2.5 Risers

SGN have completed surveys of all risers within buildings of 6 or more storeys, known as high rise. Data is held both within Maximo and within the Riser Risk Database. Regular validation ensures that

these data sources are consistent. These surveys have been undertaken before and during GD1. As such, the asset position as at 1st April 2013 has been derived taking into account the date of the survey and any known activity in the period.

Data for risers within buildings of between three and five storeys is known only where SGN has been called to site to undertake repair activity. In such cases, the riser is surveyed and records input into our repositories. SGN is currently progressing a detailed survey of all buildings termed, medium rise, and expects to have an updated data set available by the commencement of GD2. In the meantime, SGN has ONLY reported against the known risers already captured within Maximo and the Riser Risk Model. NO estimate has been included of risers not currently captured within our repositories.

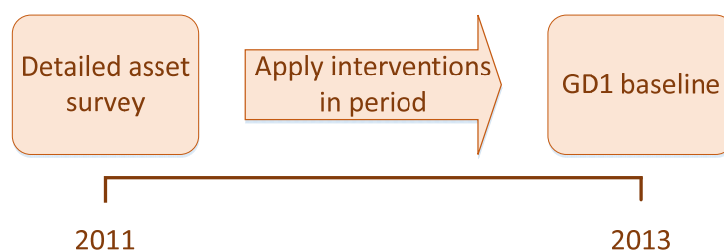
As is the case with services, failure data is available from Maximo and is available historically.

In order to assess the risk associated with risers, SGN developed a risk assessment methodology in conjunction with consultants, DNV GL. Where any riser is identified, a risk assessment proforma is completed and the data is entered onto the Riser Risk Database. During the development of the MRS model for risers, DNV GL used SGN's data for testing and validation purposes. As such, SGN is able to utilise this data to provide a measure of riser condition.

2.6 Offtakes and PRS

As part of the requirement to develop a GDN specific methodology for health and criticality indices in 2010/11, SGN employed Parsons Brinckerhoff to develop a risk scoring matrix. Then, in 2011, we undertook an in-depth survey of our assets including data collection and a full photographic record, which was input into the Health and Criticality Database. **The data capture process involved both on-site and desk top survey with the use of existing company systems to determine the health, criticality and risk of our assets. The survey was inclusive of all assets including gas pre heat, civils, Electrical and Instrumentation, metering and odorant systems.** SGN used this data in order to generate the 2017 submission. This data is recorded within the Health and Criticality Database, a Microsoft Access database constructed to hold the results of the surveys.

Using our data from 2011, SGN applied any interventions delivered between the date of the survey in 2011 and the start of GD1 in 2013 to derive the position as at 1st April 2013. This was done utilising the existing rules and processes within the methodology.



Fault data, namely 'high priority' telemetered faults taken from the Gas Control Centre SCADA system and significant and 'Imminent' (A1) and 'significant' (A2) faults found during examinations in accordance with the Pressure Systems Safety Regulations (PSSR) and recorded within Maximo, are robustly recorded for 2013 and for at least three prior years. This data will be used to calculate the probability of failure and the condition grade of assets.

SGN has identified which fault data relates to which failure mode or condition grade. For instance, failures of pre-heating systems relate to failure modes and are identified wholly through telemetry either by a boiler or a low outlet temperature alarm while integrity related faults of filters relate to the condition grade and are observed through PSSR examinations.

Instances of telemetered faults may vary due to local factors, such as high flow, temperature etc. In order to derive weighted average rates, data over three years was used.

Instances of integrity faults from PSSR have been considered over three years as such defects are not transient and define the overall condition of the assets.

Condition factors were taken from the Health and Criticality database, which is supported by detailed photographic evidence.

SGN has implemented a procedure for the condition survey of all relevant assets, CM/4 part 1. This survey was implemented in 2016 and it is anticipated that approximately 40% of the Offtake and PRS populations will be surveyed prior to the commencement of GD/2. This information will therefore enable a more accurate assessment of Offtake and PRS condition in the GD2 models.

2.7 Governors

In the original workbooks, governor data was analysed in cohorts by governor type and configuration. In the new models, governors have been itemised.

The asset base in 2013 was interpolated taking current data from our core asset repository, Maximo, and reversing interventions.

SGN undertook surveys of governors recording location, asset details and configuration prior to the commencement of GD1 for the purposes of accurately managing Reliability Centred Maintenance (RCM). These data sets were used to validate the asset data.

SGN has not, as yet, undertaken a detailed condition survey. As a result, the condition of assets has been inferred from location (for example, near the coast, located below ground in pits) and age. SGN HAS NOT adjusted condition grades to take into account interventions detailed within the Final Proposals. Workload within the Final Proposals for governors is based primarily on obsolescence and failure modes for certain vulnerable governors (ERS modules prone to flooding and overpressurisation). As such, condition grades have limited impact on the prioritisation of interventions.

SGN is currently developing a procedure for the condition survey of all relevant assets, CM/4 part 2. This survey will be implemented in 2018 and it is anticipated that approximately 25% of the governor population will be surveyed prior to the commencement of GD/2. This information will therefore enable a more accurate assessment of governor condition in the GD2 models.

Fault data for governors is recorded using the process defined in management procedure, Fault/1. Data is recorded within Maximo and is used to prescribe maintenance frequencies in accordance with RCM. This failure data is recorded historically and relevant data has been used in the MRS model.

3. Interventions

There are two main types of intervention that can be considered within the model that are in line with our original investment plan as amended by the Final Proposals:

Replacement – a proactive intervention that replaces an asset or a proportion of the asset population with new assets.

- With like for like assets
- With different assets, such as a different material, new model, etc.

Refurbishment – a proactive intervention that extends the life of an asset.

A reactive only (i.e. repair) intervention regime will be considered the baseline strategy in which other regimes will be compared against. Combinations of the proactive interventions are also considered.

As an example of how interventions have been applied, the following includes an extract of the SGN business plan for PRS in Southern Network:

Site / Intervention			Business Plan	Final Proposals	Intervention		
					Filters	Slam shuts and regulators	Pre heating
PRS	Capacity	Newton Longville	1	1	Site rebuild	Site rebuild	Site rebuild
		Chichester	1	1	Site rebuild	Site rebuild	Site rebuild
		Paradise Lane	1	1	Site rebuild	Site rebuild	Site rebuild
		Wilmington	1	1	Site rebuild	Site rebuild	Site rebuild
		Croydon	1	1	Site rebuild	Site rebuild	Site rebuild
		Lordswood	1	1	Site rebuild	Site rebuild	Site rebuild
		Battle MP	1	1	Site rebuild	Site rebuild	Site rebuild
	Integrity	Major rebuild	17	8	Site rebuild	Site rebuild	Site rebuild
		Gas pre-heat system replacement	16	8			System rebuild
		Component upgrade (regulators etc.)	13	6		System rebuild	
		Site fabric upgrade	40	20	Civils / fencing	Civils / fencing	Civils / fencing
	Security at cat. A1, A2 sites	29	15	Fencing	Fencing	Fencing	

Columns 1 to 4 itemise what was included within the business plan.

The regulator reduced the funding for unnamed PRS projects within SGN and the workload within Final Proposals was reduced accordingly (see column 5).

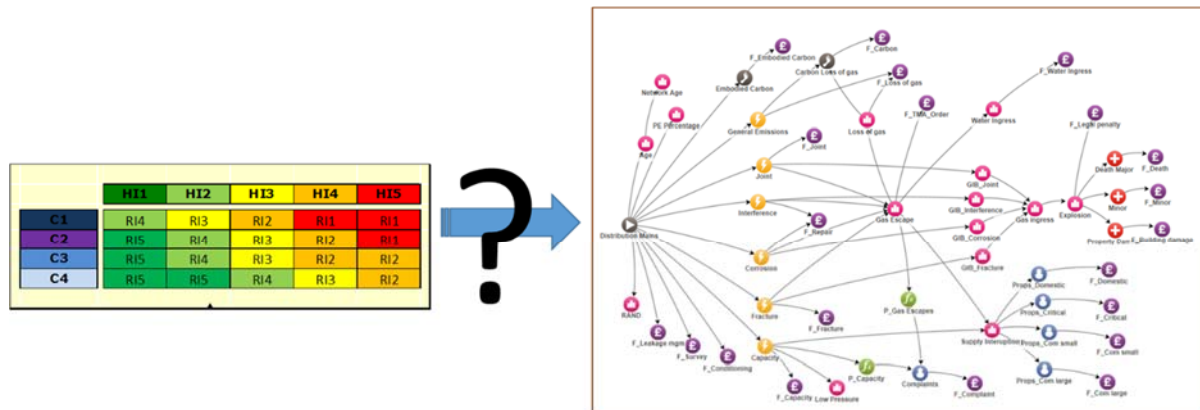
The interventions used within the MRS models have then been mapped directly from the workload type and extent. For, example a site rebuild applies to all elements on site, while a pre-heater system replacement obviously only applied to pre-heating.

A similar arrangement has been applied to all asset groups.

As mentioned previously, the funding for governors within Final Proposals reduced SGN’s plan to replace all governors to replacing only 50% and refurbishing the remainder. As a result, the full replacement intervention was applied to an equivalent number of assets and the refurbishment intervention was applied to the remainder of the plan.

3.1 Mapping interventions

As mentioned previously, the criteria for health and criticality indices was unique to SGN and, in many cases, differed considerably from the mapping within the MRS models. As such, interventions could not be directly mapped from the original workbooks into the MRS models.



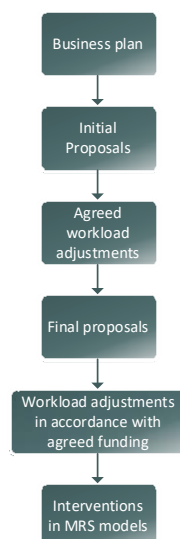
Instead, the methodology used for interventions within the original workbook was analysed and replicated within the MRS models. For example:

- The business plan called for the replacement of ERS modules due to the units being exposed to a flood risk and the flood water causing overpressurisation of the downstream system. In such instances, interventions within the MRS models were applied to the relevant asset group taking into account criticality in terms of affected supply points.
- The business plan called for the replacement of PRS components on the basis of obsolescence and condition. This was explained within the SGN specific methodology for PRS and Offtakes derived by SGN and submitted to the regulator previously. Interventions within the MRS models therefore focused on condition and obsolescence with due consideration to the scale of a supply losses in the event of an incident.

In summary, the application of interventions in order to derive the position as at 31st March 2021 ‘With Intervention’ was to take the relevant elements of the business plan, to adjust workloads and volumes as agreed as part of Initial and Final Proposals, then to apply directly equivalent interventions within the MRS models.

Maintenance type activities including examinations, inspections, repairs and revalidations have NOT been included as interventions within the model.

In order to derive the actual position, only those equivalent interventions as used to define targets are used within the MRS models. Although only the equivalent interventions are captured, these may be on different assets to those within the plan or at different levels of workload. SGN continually strive to apply best practice in the management of our assets and will continue to modify our workloads to ensure we achieve the best outcome for our customers, the general public, the environment and our shareholders.















4. Achieving the ‘Equally Challenging’ targets

A key requirement of Special Condition 4H is that this rebaselining must be:

- Consistent with Final Proposals
- Remain equally as challenging as those set out in the original Workbooks

In order to demonstrate that the targets defined by the new MRS models have an equivalent impact as the targets contained within the original workbooks SGN employed four tests as follows:

Test	Description	Assessment criteria
1	Asset base test To ensure that the asset base used in the MRS models reflects the actual asset base in 2013	 Model exactly represents the 2013 asset base
		 Model contains best available data, but may be minor errors
		 Model contains significant number of assumptions
2	Volumes of interventions test To ensure the volume of interventions reflects those detailed within Final Proposals	 Model exactly represents interventions within FP
		 Model contains a number of assumptions in defining interventions
		 Model contains a significant number of assumptions in defining interventions
3	Asset condition and performance test To ensure that the condition and performance of assets as recorded in the MRS models reflects that which was prevalent in 2013	 Model exactly represents the condition and performance of assets in 2013
		 Model contains a number of assumptions in defining condition and performance
		 Model contains a significant number of assumptions in defining condition and performance
4	Consequential test To identify whether any interventions applied in the MRS models conflicts with those in the original workbooks	 Model exactly represents interventions within original workbooks
		 Model contains a number of assumptions when translating interventions from original workbooks
		 Model contains a significant number of assumptions when translating interventions from original workbooks

4.1 Summary of results

Asset Category		Tests			
Primary group	Sub Asset	Test 1 – asset base	Test 2 – volumes of intervention	Test 3 – asset condition and performance	Test 4 – consequence
LTS	OLI 1	Asset base fully recorded	Interventions direly translated from FP	Condition data fully available. Failure data taken from industry data pool	Interventions fully mapped from original workbooks
	Oli4				
Mains	Iron	Asset base fully recorded			
	Steel	Some steel <2" dia. not recorded			
	PE	Asset base fully recorded			
Service	PE	Asset base recorded following replacement		Performance fully recorded.	
	Non PE	Not all steel services recorded. Further validation of numbers against other datasets (e.g. MPRN) is required to confirm populations.		Performance fully assessed using Predictive Analytics as developed by SGN in conjunction with Trinity Horne. Information on asset condition being developed using service hotspot tool	
Risers		Data only represents known population – medium rise buildings to be surveyed.		Condition data from Riser Risk Model follows REP/3 procedure	

		Limited data on laterals, which requires further validation.			
Offtake	Filters	Data from detailed surveys undertaken immediately prior to GD1		Condition data taken from 2011 survey. Performance data fully recorded.	
	Pressure control				
	Pre heat				
	Odourant				
	Metering				
PRS	Filters	Data from detailed surveys undertaken immediately prior to GD1		Condition data taken from 2011 survey. Performance data fully recorded.	
	Pressure control				
	Pre heat				
Governors	District	Asset base recorded following survey immediately prior to GD1		Failure rates taken directly from RCM. However, limited surveys of condition have, so far, been undertaken.	Data within MRS further enhanced by separately identifying each asset
	I & C				
	Service	Surveys ongoing to confirm population and configuration			

Appendix A - References

- Scotia Gas RIIO GD1 Assessment Methodology Report Draft A dated 7th July 2017
SGN Health and Criticality Indices methodology - Report by Parsons Brinkerhoff
- RP6 SGN_Southern New Asset Health Matrix 180113_v12 dated 18th January 2013
RP6 SGN_Scotland New Asset Health Matrix 180113_v12 dated 18th January 2013
Final workbook submissions to Ofgem
- Network Output Measures Health and Risk Reporting Methodology and Framework – Rebasing Methodologies undated
Submission to Ofgem by the SRWG

