# RIIO GD2 Business Plan Appendix Transmission Integrity December 2019



Complete network diagram with explanations at chapter 13



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# **1** Overview

## **1.1** Scope of this appendix

Our Transmission system comprises the following:

Offtakes. We have 30 offtakes (12 in Southern and 18 in Scotland) that accept gas into Local Distribution Zones (LDZ) from the National Transmission System (NTS). The primary role of the offtake is to control and meter the volume and the energy of the gas as part of the custody transfer from the NTS into SGN and to odourise the gas. An offtake typically includes filtration, full energy metering, pre-heating, volumetric control, pressure reduction and odorisation systems. Offtakes vary greatly in size supplying as little as 0.034 million scm/day and up to 24 million scm/day.

Entry point mechanical assets. We have seven entry points into our transmission systems (six in Southern and one in Scotland). These are assets associated with the point of entry for gas coming onto the Transmission network directly from biomethane, liquified natural gas facilities or oil and gas exploration facilities. These assets include valves, filtration, metering, pre-heating, pressure reduction and odorisation systems.

Local Transmission System (LTS) Pipelines. We have approximately 3,122km (1,747km in Southern and 1,374km in Scotland) of transmission pipelines with diameters between 100mm and 1,200mm and operating pressures between 14barg and 85barg. The LTS transports gas around our LDZs from the offtakes to the PRS. LTS pipelines include pig traps, exposed and buried crossings including any support structures, valves, marker posts, sleeves, cathodic protection and other ancillary systems.

Pressure Reduction Stations (PRSs). We have around 290 PRSs (160 in Southern and 130 in Scotland) that reduce the pressure from the LTS into the intermediate (2barg to 7barg), medium (75mbarg to 2barg) and low (up to 75mbarg) pressure distribution systems. These typically include filtration, pre-heating, and pressure reduction.

The Transmission Integrity Plan details the capital expenditure necessary in GD2 to improve the health of assets within the LTS. During GD1, we embraced the concepts of health, including reliability, condition and deterioration, and consequence as covered by the Network Output Measures (now Network Asset Risk Measures – NARMs) in defining the need for capital intervention to maintain safety and continuity of supply and to minimise environmental risk.

This appendix covers the refurbishment and replacement of mechanical systems within the LTS and includes any electrical and instrumentation assets linked to this activity. These projects are covered by the NARMs output and are accompanied by supporting Cost Benefit Analysis (CBA).

We undertake a number of activities, some being examinations under the Pressure Systems Safety Regulations 2000 (PSSR), that constitute revalidations and recertifications for future use. These activities are also included in this Transmission Integrity Plan. However, these are not linked to NARMs as they confirm, but do not improve, asset health.

A separate plan details stand-alone electrical and instrumentation (E&I) projects (Electrical and Instrumentation) (026).

While the total volume of gas entering the networks is marginally reducing both annually and on a peak day, new developments at a local level are forcing a limited number of capacity upgrades to the LTS. Since these projects are not driven by health concerns and generate only very marginal health improvements, they have been included in a separate Capacity Management appendix (Capacity Management) (018). These projects will not form part our NARMs targets for GD2.

In GD1, a Site Physical Security Upgrade Programme (PSUP) was progressed to secure sites categorised as grade 3 or 4 under the national guidelines for Critical National Infrastructure (CNI). The work planned for GD1 will be



completed within the due timescales. However, one site, **Security**, has been recently upgraded to CNI status (category 3) and will be required in GD2. This is itemised in tab 5.14 within the Business Plan Data Templates (BPDTs) for Scotland network.

Investment activity on the five sites away from the transmission network and supplied by either Liquid Natural Gas (LNG) or Liquid Petroleum Gas (LPG) by road tankers, known as the Scottish Independent Undertakings (SIUs), is detailed within our SIU appendix 017.

It is acknowledged that GD2 will be a time of uncertainty for both the Transmission systems and for the future of gas. As such, we have decided to intervene only where necessary to maintain the safety and reliability of the assets. This minimum level of activity will therefore not impact on the overall level of maintenance that is described within our Asset Maintenance appendix (016). That appendix does not cover the revalidation activity covered in this appendix, although revalidations are co-ordinated and, in some cases, delivered by the maintenance department.

## 1.2 Impact

Catastrophic gas releases and the potential for ignition from the LTS pose immediate risks to human life and property. For that reason, the pipelines are deemed Major Accident Hazards under the Pipeline Safety Regulations 1996. The pipelines and the associated offtakes and PRS are also covered by the Pressure Systems Safety Regulations 2000 due to the potential for release of stored energy.

The LTS is critical to the continued supply of gas to around 5.9 million customers (4 million in Southern and 1.9 million in Scotland) with whole communities dependent on a few, often only one, offtake, pipeline or PRS. We need a continued investment programme to ensure that the assets are fit for purpose and are maintained 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 also 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; this framework is supported by a comprehensive suite of industry recommendations and guidance and internal procedures.

## 1.3 Approach to GD2

The majority of our transmission assets are between 40 and 60 years old (70% of offtakes and PRS, and 60% of pipelines with similar distributions in both Southern and Scotland) and, as such, exhibit increased deterioration in condition and performance necessitating appropriate intervention to keep them operating in a safe and reliable manner. Without this continued investment, the probability of a major incident will increase. Nevertheless, because of the uncertainty around the future of gas and the likely pace of change, our strategy for GD2 is to do the minimum: repairing where possible, through to refurbishment, component or system, replacement only of those items that need replacement or finally a full rebuild; we term this strategy the '4Rs' and is illustrated in the figure 1:



#### Figure 1: Four Rs strategy



Prior to GD1, we commissioned a major site-based inspection programme of all Offtakes and PRSs. This informed our business plans for GD1 and supported our initial population of the 'Network Output Measures' as defined in Special Condition 4G of our gas transporter's licence. In 2015, we initiated a long-term detailed condition inspection programme, known by the procedure reference, CM/4, which requires a full inspection of all sites at least every 12 years. The inspection considers every pipe section and includes removal of pipe supports, lagging and other obstructions, where corrosion could hide. In the early years of the programme we have focused on those assets considered to be at the highest health related risk. This rigorous inspection regime, alongside a number of other revalidation programmes primarily linked to PSSR, informs our GD2 strategy to manage asset condition.

## 1.4 Forecast investment

We have set out our forecast expenditure for GD2 with the costs separated into the categories of integrity and compliance; integrity has been further itemised by asset group, namely LTS pipelines, offtakes and PRS. Our historical expenditure covers both integrity and compliance but is only itemised by asset group.

We will invest £186.63m on Integrity and Compliance including efficiencies and overheads; £23.96m at our offtakes over the five years of GD2.

We will invest nearly £31.01m in LTS pipelines, of which £28.51m is identified as named projects and this is 50% reduction compared to the GD1 levels. One significant pipeline project near Dunkeld in Scotland has been estimated at £25.77m and accounts for 50% of the investment on all pipelines in GD2. This project will resolve escalating risks from fluvial erosion by the River Tay, a river that has caused numerous problems for our LTS pipelines in GD1.

For PRSs we will invest £87.93m over the course of GD2, which all bar £1.86m comprises named projects. During GD1, we moved expenditure to focus on PRSs due to their risk profile and we will maintain that focus during GD2.

We will invest £43.73m in compliance activities over the five years of GD2, of which £34m has been identified in the project tables below. The remaining will be individual projects with a value less than £0.5m.



Altogether we expect to spend an average of £37.33m in each year of GD2 (£18.65m in Southern, £18.68m in Scotland), which compares to £36.6m on average for GD1 and £43.44m in the last five years of GD1, presenting a similar investment overall and a reduction in annual average investment of approximately 25% over the last five years of GD1.

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
Compliance									8.3	8.8	7.8	9.3	9.6
LTS pipelines	8.2	11.4	1.8	14.3	15.0	19.9	4.3	2.9	1.5	7.8	9.9	11.2	0.6
Offtakes	1.4	0.3	0.8	1.2	2.2	5.8	13.9	10.9	2.3	4.5	9.2	7.3	0.7
PRSs	3.9	13.6	23.9	36.6	27.4	29.9	18.7	11.3	9.7	17.5	27.2	20.0	13.5
Storage	7.4	1.0	1.6	0.6	0.2	-	-	2.2	-	-	-	-	-
Embedded Entry	-	0.5	-0.2	-	-	0.1	-	-	-	-	-	-	-
Total	20.8	26.9	27.9	52.7	44.7	55.7	36.8	27.3	21.8	38.6	54.0	47.9	24.4
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
Compliance									3.9	3.7	3.7	4.0	4.3
LTS pipelines	6.2	10.2	1.6	10.7	9.4	17.4	4.3	2.3	1.1	5.6	9.9	10.9	0.6
Offtakes	1.4	0.2	0.7	1.1	1.2	3.7	6.2	1.1	1.3	0.5	-	0.1	-
PRSs	1.2	6.9	12.8	14.1	9.0	11.4	5.4	5.8	4.6	8.3	15.6	7.7	7.5
Storage	2.8	0.8	0.1	0.1	0.1	-	-	2.2	-	-	-	-	-
Embedded Entry	-	-	-0.2	-0.1	-0.2	0.1	-	-	-	-	-	-	-
Total	11.7	18.0	15.0	25.9	19.5	32.6	16.0	11.4	11.1	18.1	29.2	22.7	12.4
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
Compliance									4.4	5.0	4.1	5.2	5.2
LTS pipelines	2.0	1.2	0.2	3.5	5.6	2.5	-	0.6	0.4	2.3	-	0.3	-
Offtakes	0.0	0.1	0.1	0.1	0.9	2.1	7.6	9.7	0.9	4.1	9.2	7.3	0.7
PRSs	2.6	6.7	11.1	22.5	18.4	18.5	13.2	5.5	5.1	9.2	11.5	12.3	6.1
Storage	4.6	0.2	1.5	0.5	0.1	-	-		-	-	-	-	-
Embedded Entry	-	0.5	-	0.1	0.2	-	-		  -	-	-	-	-
Total	9.2	8.8	12.9	26.8	25.2	23.1	20.9	15.8	10.8	20.5	24.8	25.2	12.0

 Table 1: GD2 Transmission Integrity and compliance investment proposal

Hatched areas do not have directly comparable data for GD1 as they were not separately identified in the GD1 allowances. These figures are gross including capitalised overheads and an expected efficiency saving of 0.5% per annum.



# 2 Transmission Integrity within the Business Plan

#### Figure 2: Appendix structure





Transmission assets are deemed 'maintained'; that is, their continued integrity and reliability is ensured through a programme of routine interventions, which are defined as follows:

## Inspection is the primary philosophy, by which SGN routinely confirms assets remain reliable and in good condition. The activity comprises either a visual assessment of an asset to identify deterioration (such as corrosion), or functional checks, particularly safety devices and standby systems to confirm reliability. Inspection is undertaken at a variety of frequencies, which are both calendar and risk based.

Maintenance (e.g. overhauls) are generally undertaken as directed after inspection, although certain types of equipment (e.g. control valves) require some routine maintenance, such as oil replenishment.

Repair is where a functional check or telemetry alert identifies a fault on an asset, which may need either repair or replacement, typically, of consumable items such as diaphragms.

Inspection, maintenance and repair activities do not improve the health or lifespan of the asset and are therefore funded through the opex allowances. This work is fully described within the Asset Maintenance appendix (016).

#### Figure 3 Intervention options



Revalidation covers key examinations that allow us to recertify the asset for continued operation for 10 or more years. Such activities are normally defined within our WSoE under PSSR and include

in-line inspection of pipelines and pre-heater revalidations. Our primary condition inspection programme, CM/4, also allows systems to be recertified for 12 years and is deemed a revalidation programme. Since revalidation is vital in demonstrating an asset is fit for purpose for an extended period, we capitalise this work and it is therefore included within this plan.

Refurbishment covers a range of activities that extend the life of an existing asset, such as full repainting to reduce the rate of deterioration or the replacement of all soft parts, deteriorating components, housings and foundations.

Replacement is the replacement of major components or the rebuild of a full system.

Removal covers the isolation and removal of redundant assets. Assets are deemed redundant where they do not support customers and where the resilience of the network is not adversely affected.

Revalidation, refurbishment, replacement and removal interventions are covered by this Transmission Integrity Business Plan. Since we are programming the minimum work to achieve a safe and reliable network and since a number of inspection regimes are currently calendar based, the Transmission Integrity plan has a negligible impact on the proposals for Maintenance in GD2.



Growth covers the upsizing of existing assets or the construction of new assets to meet increasing demand. In general, we are forecasting a marginal reduction of demand into the networks over the next 10 years. However, local developments of new housing and industrial units will mean some growth-related investment at specific PRS and the associated LTS pipelines feeding the sites. Such growth will also necessitate reinforcement of the distribution networks. For this reason, Transmission related interventions to meet local growth have been included within the Capacity Management appendix (018).

Resilience covers the construction of new assets to reduce the consequence of failure of existing assets on security of supply. SGN is satisfied with the resilience of our existing assets and therefore propose no Resilience related projects in GD2 for Transmission assets.

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 and learnings

## 3.1 Overview of service delivered

As part of our preparations for GD1, we began to focus on the main failure modes of our Transmission assets. Significant faults from our inspection regimes and high priority alarms from our real-time monitoring of sites were used to gauge asset reliability. A comprehensive survey of our key sites was used to assess asset condition. The criticality of assets was also assessed taking into account numbers of customers supported and the impacts of failure. This information was used to inform our Business Plan.

For GD1, we requested £124.9m for Transmission projects in Southern and £137.0m in Scotland (2009/10 cost base). These sums included proposals for some growth and E&I projects, but not for Compliance related revalidations (these sums also do not include capitalised overheads). Ofgem made reductions of £34.03m in Southern and £42.04m in Scotland to bring allowances for PRS into line with historic expenditures. Ofgem made a further reduction of £9.6m in relation to two discounted schemes for reinforcement of LTS pipelines in Scotland.



Figure 4: GD1 Business Plan verses allowances

Ofgem proposed a 'secondary deliverable' output to monitor and report on the workloads within the Transmission and other plans, known as the Network Output Measures (NOMs) and defined within Special Condition 4G of the gas transporters' licence. These comprised the following individual measures:

- Asset Health Measure
- Network Criticality Measure
- Network Risk Measure
- Network Capacity Measure

Asset health, criticality and risk were initially intended to be reported as indices. Until late 2012, the mechanisms defining these indices was to be network specific and until 2014, they were planned to be consistent across all gas distribution networks. Subsequently, a methodology to derive network risk as a monetary measure (Monetised Risk) has 'not been rejected' by Ofgem and targets for GD1 have been consulted upon and accepted. The methodology has been published by the Safety and Reliability Working Group, of which we are a full member, and is available on request.



## 3.2 Legislative background

Two key pieces of legislation are instrumental in ensuring the integrity of the LTS: Pressure Systems Safety Regulations 2000 (PSSR) and Pipeline Safety Regulations 1996 (PSR).

## Pressure Systems Safety Regulations 2000 (PSSR)

PSSR covers the safe design and operation of pressure systems to reduce the risk of failure of a pressure system 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 document this requirement through our Management Procedure, SGN/PM/PS/3. The examinations include:

- In-line inspection of pipelines,
- Examination of heat exchangers including non-destructive testing (NDT) and hydrostatic test,
- Examination of filters including NDT.

Each examination categorises an asset according to:

- Category C, a declaration of no faults,
- Category B, a fault that is not judged dangerous or will give rise to danger before the next examination,
- Category A2, a 'significant' fault which does not give rise to immediate danger, but action is required to prevent system failure prior to the next examination, and
- Category A1, is considered to result in immediate danger, with immediate notification to the user and Competent Person. The competent inspector will not leave the site until the situation is rectified.

Any postponements of examinations must be notified in writing to the Health and Safety Executive (HSE).

A number of examinations under PSSR are deemed to be revalidations and are included within this appendix.

## Pipeline Safety Regulations 1996 (PSR)

PSR provides an integrated, goal-setting risk-based approach to the management of pipelines and covers design, construction, operation, maintenance and decommissioning activities. We demonstrate 'best practice' through the adherence to industry recommendations including those of the Institution of Gas Engineers and Managers (IGEM) as well as the UK Onshore Pipeline Operators Association (UKOPA) and the Engineering Equipment and Materials Users Association (EEMUA). The following recommendations and guidance provide the core structure for our operations:

- IGEM/TD/1 steel pipelines and associated installations for high pressure gas transmission,
- IGEM/TD/13 pressure regulating Installations for Natural Gas, Liquified Petroleum Gas and Liquified Petroleum Gas/Air,
- IGEM/SR/25 Hazardous Area Classification of Natural Gas Installations, and
- EEMUA/191 Alarm Systems a guide to design, management and procurement.

These recommendations are implemented through our management procedures which have been developed to support compliance, ensure continued fitness for purpose and incorporate best practice.

## **Condition inspection programme**

We have implemented a formal condition assessment programme, SGN/PM/CM/4 part 1, which includes a detailed inspection of all above ground assets at least every 12 years, including close inspection of pipework under lagging and pipe supports and through wall transitions. Any defects are fully assessed and quantified, prior to the remediation of any critical defects. With our established CM/4 survey programme, we believe that we are network leaders in the quality of assets assessment which gives us confidence in the quality of the condition

assessment used in the investment assessment process.

## 3.3 GD1 output delivery

The Secondary Deliverable output under the RIIO framework is the Network Output Measures (NOMs) as defined within Special Condition 4G of our gas transporter's licence. The NOMs methodology published by the gas distribution networks in 2015 details how, using asset reliability and condition as a measure of health and consequence of failure (expressed in monetary terms) and the associated probability of that consequence occurring as a measure of criticality, a monetised risk (health x consequence x probability of consequence) for each asset or cohort of assets can be calculated. By comparing the monetised risk without intervention with the reduced risk with intervention, a 'change in risk' can be determined, which forms the basis of the secondary deliverable output.

In previous price control periods, there have been few mechanisms to monitor the delivery of investment to improve integrity. NOMs provide that mechanism in GD1 with a single target 'change in risk' or delta for each network comprising the change in risk for all relevant assets.

This methodology is applied to eight categories of 'primary' assets, which encompass greater than 95% of relevant capex expenditure. The relevant Transmission assets are as follows:

No	Primary Assets	Secondary Asset	Units
1	LTS Pipelines	LTS Pipelines – Piggable	Km
		LTS Pipelines – Non Piggable	Km
5	Offtake/PRS Filters and	Offtake Filters	Systems
	Pressure Control	PRS Filters	Systems
		Offtake Slamshut/Regulators	Systems
		PRS Slamshut/Regulators	Systems
6	Offtake/PRS Pre-heating	Offtake Pre-heating	Systems
		PRS Pre-heating	Systems
7	Offtake Odorant and Metering	Odorisation and Metering	Systems

#### Table 2: Relevant Transmission Assets

On 12 June 2019, Ofgem published its 'Decision to approve and direct the rebased Network Outputs for Gas Distribution Network operators'. In summary, this was the approval of the networks NOMs targets for GD1.

## 3.3.1 Southern targets

#### Table 3: Agreed targets for Transmission Assets Southern (£m)

Southern Assets	2013	2021 Without Investment	2021 With Investment	Target Delta (change in risk)
LTS Pipelines	36.33	36.34	36.32	0.02
Offtakes	10.46	10.84	6.78	4.06
PRS	82.04	88.39	47.96	40.43
Total	128.83	135.57	91.06	44.51



#### As at 31 March 2019, we had delivered the following:

Southern Assets	2021 Without Investment	2019 With Investment	Actual Delta (change in risk)
LTS Pipelines	36.33	35.50	0.83
Offtakes	11.37	9.46	1.91
PRS	88.38	47.54	40.84
Total	136.09	92.50	43.58

#### Table 4: Actual delivery for Transmission Assets Southern (£m)

We have achieved 97.9% of our target risk reduction for Transmission assets. In the last two years of GD1 we will deliver an additional three further significant construction projects – the rebuilds of Farningham Offtake and Wilmington and Croydon PRS. The offtake is a major feed into the South East Local Distribution Zone, while the two PRS are major feeds into the South London network. All three will deliver further risk reductions in GD1.

The large target risk reduction for PRS has been delivered through the replacement of filters. Filters are examined in accordance with PSSR every 12 years using detailed NDT techniques. In Southern, a significant number of filters have been condemned after crack-like defects were identified and the resultant data was scrutinised by our independent competent body, who sentenced the defects.

## 3.3.2 Scotland targets

#### Table 5: Agreed targets for Transmission Assets Scotland (£m)

Scotland Assets	2013	2021 Without Investment	2021 With Investment	Target Delta (change in risk)
LTS Pipelines	27.84	366.29	20.79	345.50
Offtakes	5.93	6.01	4.82	1.19
PRS	16.11	16.58	12.46	4.12
Network	49.88	388.88	38.07	350.81

The large risk in 2021 without intervention for LTS pipelines is primarily due to a capacity constraint on the Security The system comprises a

single spine of 300mm and 250mm diameter pipelines operating at pressures up to 70barg and is near to capacity. Until 2016, seven large users held interruptible contracts allowing SGN to call for a cessation of supply at peak demands. Modification 90 under the Uniform Network Code allowed these users to revert to firm contracts causing a serious capacity constraint in October 2016. We installed the planned reinforcement earlier that year. Capacity constraints account for £345.2m of risk reduction for LTS pipelines.

As at 31 March 2019, we had delivered the following:

#### Table 6: Actual delivery for Transmission Assets Scotland (£m)

Southern Assets	2021 Without	2019 With	Actual Delta
	Investment	Investment	(change in risk)
LTS Pipelines	366.29	20.44	345.85
Offtakes	6.28	6.15	0.14
PRS	28.44	20.50	7.94
Total	401.01	47.09	353.93



In Scotland, the majority of risk reduction has been delivered through the replacement of PRS pre-heating and PRS pressure reduction systems (slam-shuts and regulators). In Scotland pre-heaters have been a particular issue due to the colder weather and the prevalence of small inefficient and failing water bath heaters. Furthermore approximately 70 sites had complicated, ageing and failing lineguard systems providing stream selection for slam-shuts. This risk materialised in December 2008 when the faulty lineguard system at Kelso PRS caused the complete failure of the site with the consequential loss of supply to around 1,600 properties in heavy snow. In December 2012, a significant fault was also observed at Greenock PRS and as a result we have been progressing the replacement of these systems during GD1. An incident at Torphichen PRS in 2017 caused the loss of supply to around 300 customers due to the deterioration of the pressure control system. Due compensation was paid to affected customers in accordance with the relevant obligations.

## 3.4 GD1 customer experience

The customer has generally experienced a wholly reliable service from the transmission systems in both Southern and Scotland networks with supply security from the Transmission system being consistently greater than 99.99999%. Only one incident affecting supply security in Scotland occurred at the village of Torphichen, where around 300 customers lost their supply on 17 December 2017 due to a fault within the pressure control system. In this case, supplies were returned within a few days.

## 3.5 GD1 allowances and expenditure

The allowances and corresponding expenditure during GD1 is as follows (note: expenditure figures for 2019/20 and 2020/21 represent the current forecasts):

Transmission (£M 18/19 prices)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	32.5	31.1	31.0	38.9	38.8	42.7	37.1	35.2	287.4
Expenditure (forecast post 18/19)	20.9	26.8	27.9	52.7	44.7	55.7	36.9	27.2	292.8
Variance	11.6	4.3	3.1	-13.8	-5.9	-13.0	0.2	8.0	-5.4

#### Table 7: SGN GD1 allowances and expenditure

#### Table 8: Southern GD1 allowances and expenditure

Transmission (£M 18/19 prices)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	14.6	13.1	16.5	19.1	22.3	26.5	22.5	21.0	155.6
Expenditure (forecast post 18/19)	9.2	8.8	12.9	26.8	25.2	23.1	20.9	15.8	142.7
Variance	5.4	4.3	3.6	-7.7	-2.9	3.4	1.6	5.2	12.9

## Table 9: Scotland GD1 allowances and expenditure

Transmission (£M 18/19 prices)	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	Total
Allowances	17.9	18.0	14.5	19.8	16.5	16.2	14.6	14.2	131.7
Expenditure (forecast post 18/19)	11.7	18.0	15.0	25.9	19.5	32.6	16.0	11.4	150.1
Variance	6.2	0.0	-0.5	-6.1	-3.0	-16.4	-1.4	2.8	-18.4



## 3.5.1 Southern allowances

The GD1 final proposals for our Southern network allowed £90.9m (in 2009/10 prices and not including overheads) across all Transmission assets. These allowances cover of the following investment areas:

- Mechanical integrity investment to resolve condition and reliability issues associated with offtakes, PRS and LTS pipelines accounted for £61.9m of the £90.9m final allocation,
- Electrical and Instrumentation integrity investment to resolve condition and end-of-life issues with monitoring or control systems, electrical supplies and offtake metering systems accounted for £13.74m in 2009/10 prices of the final allocation, and
- Capacity increases in demand from the downstream distribution systems requiring upgrades to PRSs or supplying pipelines. Capacity projects accounted for £15.21m of the total allowance.

Over GD1 our forecast expenditure on Transmission is £135.2m (2018/19 cost base), which compares to an allowance of £119.35m (in 2018/19 prices). While this represents an over-expenditure, Transmission Compliance related revalidations were coded to capex, but the allowances were originally captured under opex. In GD2, we are forecasting £4.84m per annum for Compliance, which if replicated in GD1 would suggest a like-for-like expenditure against the allowance of £96.48m – an underspend of 19.2%. A number of drivers have resulted in differences between the interventions in the Business Plan and those delivered, including the following:

At the start of GD1 we operated five high pressure storage sites to provide diurnal storage for the network, i.e. balancing the variations in gas demand between the breakfast and dinner time peak usage and the lower off-peak usage at night. Following an extensive detailed review of our short and long-term gas demands and the availability of diurnal storage from both the NTS and linepack<sup>1</sup> from our own LTS pipelines, we identified an opportunity to cease operation of these costly high-pressure storage sites and decommission the sites.

At the start of GD1 we initially targeted significant work on the LTS pipelines to replace and upgrade Above Ground Installations (AGIs), remediate exposed crossing on the LTS, and to refurbish valves. However, detailed risk assessment of both LTS pipelines and PRSs highlighted the greater need to intervene on PRSs. The monetised risk methodology provided a consistent unit of exchange (value of risk removed) that enables network companies to prioritise interventions according to the value of risk removed. Given the value of risk removed of PRSs compared to LTS pipelines, we chose to 'risk trade' between LTS pipelines targets to the higher priority PRSs. The work on PRSs included a greater number of full-site rebuilds, greater volumes of component, particularly filters, and pre-heating replacement. Filters are deemed pressure vessels under the Pressure Systems Safety Regulations 2000. As such, examinations are specified within the WSoE with a visual inspection every six years and a thorough examination using NDT every 12 years. Many filters are cast bodied rather than fabricated and can exhibit cracking in areas where stresses within the body are concentrated. Such faults are sentenced by our independent Competent Body, who have specified replacement on a number of occasions. Since the early 2000s, we have been installing packaged condensing boilers in order to maximise efficiency and to minimise the impacts on the environment. However, it is now understood that the lifespan of such systems is variable with problems within the aluminium boiler heat exchangers, where installed, caused by the modulating operation to meet gas demands. The variance between approved and actual workloads on PRS is as follows:

<sup>&</sup>lt;sup>1</sup> Storage generated within pipelines through the variation in pressures between the start of the gas day (05:00 hours) and the end of the higher demand periods (22:00 hours)



#### Table 10:Southern PRS workloads

Activity	Approved	Actual
Full site rebuild	8	23
Component upgrade/refurbishment	C	4
Filter replacement	0	18
Pre-heater replacement	8	25

There has been greater than anticipated work on offtakes, in particular with regards gas pre-heating and component replacement (filter replacement, pressure control and slamshut refurbishments), again this was following a full review of health and reliability and as subsequent re-alignment of investments. The variance between approved and actual workloads is as follows:

#### Table 11:Southern offtake workloads

Activity	Approved	Actual
Gas pre-heating system replacement	2	4
Gas pre-heating system refurbishment	Nil	1
Component upgrade/refurbishment	2	5

## 3.5.2 Scotland allowances

The GD1 final proposals for our Scotland network allowed £88.5m (in 2009/10 prices not including overheads) across all transmission assets. These allowances cover a number of investment areas:

Mechanical integrity – investment to resolve condition and reliability issues associated with offtakes, PRS and LTS pipelines accounted for £67.3m of the £88.5m final allocation.

Electrical and Instrumentation integrity, investment to resolve condition and end-of-life issues with monitoring or control systems, electrical supplies and offtake metering systems accounted for £13.18m of the final allocation. This is set out in the Electrical and Instrumentation appendix (026).

Capacity – increases in demand from the downstream distribution systems requiring upgrades to PRSs or supplying pipelines. The allowance for growth projects was £10.3m.

Over GD1 our forecast expenditure is £146.7m, which compares to an allowance of £116.2m (in 2018/19 prices). While this represents an over-expenditure, Transmission Compliance related revalidations were coded to capex, but the allowances were originally captured under opex. In GD2, we are forecasting £3.8m per annum for Compliance, which if replicated in GD1 would suggest a like-for-like expenditure against the allowance of £116.3m – on target.

As with Southern, we have 'risk traded' between lower risk LTS work and increased the number of interventions on PRS. SGN has suffered a number of problems with ageing slamshut and regulator control systems. An incident at Kelso PRS resulted in the loss of around 1,600 consumers in the depth of winter and was caused by failures within a deteriorating lineguard system. A failure at Torphichen PRS resulted in the loss of around 300 consumers and was caused by failures within the regulator control system. Similar issues with gas pre-heating systems to those experienced in Southern have been seen in Scotland. These have been further exacerbated by the more severe weather and the prevalence of small inefficient water bath heaters. The variance between approved and actual workloads is as follows:



#### Table 12:Scotland PRS workloads

Activity	Approved	Actual
Full site rebuild	3	12
Component upgrade/refurbishment		28
Slamshut refurbishment (lineguard)	4	5
Filter replacement		4
Pre-heater replacement	3	15

## 3.6 GD1 lessons learned

## 3.6.1 Customer related learning

Customer groups continue to be served well throughout GD1 by the Transmission systems in both Southern and Scotland networks with excellent supply security and minimal impact on safety. Customers and stakeholders, with the exception of a few large industrial loads, do not recognise the role of the Transmission system in delivering all of the gas that they use and the potential impact on safety from high-pressure assets, because the system remains very safe and very reliable. As such, it is incumbent on us to maintain this system ensuring it continues to provide the same service even though many of the assets are around 50 years in age. In GD1, we focused on maintaining a safe and reliable system at minimum cost to the customer – a practice we will also adopt in GD2.

## 3.6.2 Asset management related learning

In GD1, we focused our maintenance regimes on the identification of ageing assets including the assessment of condition through our revalidations, especially our CM/4 surveys, and the recognition of poor reliability. Accordingly, investment in GD1 has been targeted at those assets exhibiting deterioration. We have also recognised those assets that are most critical in relation to safety and supply security. In this way, we learnt from the concept of Monetised Risk encouraged by Ofgem through the Network Output Measures and these lessons form the heart of asset management. In GD1 we adopted Commercial Confidentiality capture data and facilitate assessment. We are now ready to develop these lessons into GD2 so that investment is fully targeted at those assets most in need of improvement.

A number of specific learning points in GD1 are as follows:

**PRSs.** In both Southern and Scotland, we have completed substantially greater activity levels across intervention types than allowed for at final proposals due to the updated risk assessment carried out both immediately prior to and during GD1. We delivered more 'full site rebuilds', more component upgrades to filters and pressure reduction systems and more preheating replacements. This change in the mix of workload was driven directly from our detailed condition surveys and assessment of asset reliability including our surveys undertaken in accordance with procedure, CM/4 part 1.

**Offtakes.** In Southern we have carried out more work than allowed for, due to health issues identified during survey. In particular, we needed to address emerging issues with condensing boiler systems and we also targeted refurbishment of control valves to extend their useful life. In Scotland, the workloads on offtakes were as planned acknowledging fewer defects on filters, the prevalence of simpler water bath pre-heating systems and fewer control valves.



**Pipeline refurbishment.** at the start of GD1, we had planned to refurbish 10km of pipeline in Southern and 6km in Scotland. However, a detailed risk assessment of both LTS pipelines and PRSs highlighted the greater need to intervene on PRS. As a result, SGN chose to 'risk trade' allowances from LTS pipelines to PRS.

**Online inspection.** OLI/1 refers to the ability to internally inspect the wall of the pipeline by intelligent vehicles or pigs transported through the pipe along with the flow of gas. OLI/4 refers to pipelines that are only inspectable using overground surveys, which are far less comprehensive. The OLI tool is propelled through the pipeline with the flow of gas. Where that flowrate is low, there is insufficient motive force to drive the tool at the required speed, typically 3m/s. In GD1 we planned to convert seven pipelines to inspection by OLI/1 (two in Southern and five in Scotland), but only one OLI/4 pipeline in Southern could be adapted to accommodate the in-line inspection tool; only the Bulbury to Sopley pipeline was identified as exhibiting sufficient flow to allow conversion to OLI/1. Other OLI/4 pipelines either have low flowrates or were of insufficient length to warrant the costly process of conversion to OLI/1. We have implemented a process whereby a previous cap on inspection frequencies at 15 years has been extended to 20 years where the condition of the pipeline permits. This innovation is exclusive to SGN and is an example of promoting efficient expenditure.

**Nitrogen sleeves.** Existing LTS pipelines are routed through sleeves at points of potential damage (e.g. major road and rail crossings) to avoid damage. These sleeves are typically sealed and pressurised with nitrogen to 1barg. The pressure in these sleeves is monitored annually. Pressure losses over time indicate deterioration of the sleeve. Twelve such instances (six in Scotland and six in Southern) have already been identified and have been grouted in GD1 with a further two sites being monitored, to be grouted later in the formula period. In Scotland, the regular monitoring of nitrogen sleeve pressure has not identified any required for further minor refurbishment while in Southern, 31 minor refurbishments were required. In both instances this has varied (positively and negatively) from the anticipated workload, confirming the value of effective monitoring.

**Cathodic protection systems.** Buried steel pipelines will corrode if not adequately wrapped and protected by cathodic protection. These systems are regularly checked for operation and are fully inspected to confirm the pipelines are being protected in accordance with management procedure, SGN/PM/ECP/2. Where these checks and inspections identify a failure to provide full protection, then replacement of elements, such as the transformer rectifier or the ground bed, is required. In GD1 fewer interventions have been required than identified within allowances.

**AC corrosion:** is an emerging issue and is an issue where overhead power lines are located in parallel to buried steel pipelines inducing alternating current (AC) potentials into the pipeline, which results in localised corrosion. There have been two instances (one in Scotland and one in Southern) with a further issue being investigated, no mitigation had been originally anticipated within the GD1 plan.

**AGIs, exposed crossing and refurbished valves.** As with pipeline refurbishment a detailed risk assessment highlighted the greater need to intervene on PRS sites. As a result, we chose to 'risk trade' allowances from LTS pipelines to PRSs in the majority of instances.

**Non-rechargeable projects.** In Scotland we have experienced more non-rechargeable diversions than anticipated. This included a diversion adjacent to the River Tay at Kincraigie and a crossing of the River Don due to fluvial erosion and responses to housing encroachments in Tornagrain and industrial works at Cowdenhill; the latter of which is still being progressed with difficulties experienced in obtaining the required easements for the diverted pipeline.

**Storage.** As discussed previously, at the start of GD1 we operated five high pressure storage sites in Southern to provide diurnal storage for the network which have now been decommissioned, isolated and purged. No equivalent high-pressure storage existed in Scotland other than on the SIU, which are discussed in the SIU appendix (017).



# 4 Stakeholder insight

We have undertaken a comprehensive programme of engagement with customers and stakeholders throughout the development of our GD2 business plan, helping us to better understand their priorities and test our proposals. This is described in more detail in chapter 4 of our Business Plan and the Enhanced Engagement appendix (022).

Our customers and stakeholders have told us that network safety and resilience is very important to them. While customers do not necessarily want less investment in safety and reliability, they do not see it as an area of *increasing* focus and expenditure, as they view our performance throughout GD1 has been very good and something we should seek to maintain<sup>2</sup>. Customers have also told us that keeping costs down is the top priority they would like us to focus on<sup>2</sup>. We have taken these views into consideration when developing our investment proposals for Transmission Integrity by limiting overall expenditure to the equivalent of or below GD1 levels. We have prioritised expenditure carefully based on sound engineering principles to ensure both safety and reliability are maintained.

We have adopted a strategy known as '4Rs': prioritising repair, refurbish, component replacement or full system rebuild in that order. Decisions on whether to maintain or refurbish or replace transmission assets in GD2 will depend primarily on whether a repair will mitigate the immediate defect and whether deterioration of other reliability or condition faults are likely to lead to failure.

As detailed below, investment in transmission integrity and compliance impacts most directly upon two of the three commitments at the heart of our business plan; making a positive impact and delivering a safe and efficient service.

## 4.1 Positive impact

We know our customers and stakeholders value 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.

 $\bigcirc$ 

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



<sup>2</sup> Stage 1: Explorative Qualitative Workshops and interviews (ref 002)

Our network also supplies a number of very large

gas users, such as power generators and industrial manufacturers. We have engaged with this group

indicated that a prolonged unplanned interruption

in gas supplies would significantly damage their

businesses, in most cases increasing in severity

of stakeholders specifically, who have clearly

with duration.<sup>3</sup>



<sup>&</sup>lt;sup>3</sup> Large Gas User survey (ref 076)

## 4.2 Shared future

The potential impact of new technology, policy decisions on the future role of the network and, in particular, the flows and types of gases within the system will have critical bearing on our GD2 investment strategy. In particular, the future of gas remains uncertain and will depend on legislative changes anticipated during GD2. Our engagement with customers and stakeholders has helped us better understand their views with regards the future of the network. While consideration of longer-term goals to decarbonise the UK energy system is a core commitment at the heart of our plan, the issues identified do not directly impact our investment requirements for transmission integrity and compliance. Maintaining our existing network in a safe and reliable condition is important if we are to explore the opportunity to use it more flexibly in the future as part of a decarbonised energy system.

## 4.3 Safe and efficient

The customer and stakeholder priorities of acting safety, keeping the gas flowing and keeping costs down are core to guiding the decisions that we are making within our Transmission Integrity



proposals. Our first wave of stakeholder satisfaction surveys demonstrated that 97% of stakeholders rate acting safely and keeping the gas flowing as fairly or very important, and our customer research has shown that ensuring supplies are reliable is very important for customers in all our network areas<sup>4</sup>.

We actively engage with the Health and Safety Executive (HSE) and maintain a close dialogue with this body. The HSE have conducted numerous routine inspections with SGN during GD1. The HSE conducted an Asset Integrity Inspection of both Southern and Scotland networks in June 2016, during the course of which they visited offtakes and PRS sites in both networks. We were rated in accordance with the HSE scoring methodology as follows:

10	20	30	40	50	60
Exemplary	Compliant	Broadly compliant	Poor	Very poor	Unacceptable
	$\checkmark$				

Failures on the Transmission system inevitably impact over a large area and are of a longer duration because of the engineering complexity required to complete a repair. It is therefore vital that reliability and health issues are resolved quickly and effectively before they can lead to a more serious failure. Our plan focuses on the known defects and prompt action in GD2 will ensure customers are not adversely affected.

Through our programme of research, we have explored with customers their views on making additional investment in assets where we see changes in risk resulting from factors such as environmental changes or removing redundant assets. In our first wave of 'willingness to pay' research, 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<sup>5</sup>.

At our Moving Forward Together workshops in November 2018 we asked stakeholders for views on improving resilience 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



<sup>&</sup>lt;sup>4</sup> Max diff Prioritisation Phase (Ref: 003, 004)

<sup>&</sup>lt;sup>5</sup> Stage 3: Conjoint and WtP Summary report (Valuation Phase) (ref 005)

are currently reliant on a single gas feed.

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<sup>6</sup>. At our safe and efficient workshop event in August 2019 we tested our approach to asset management with expert stakeholders, the majority of whom supported our proposals.<sup>7</sup>

As a result of this feedback, we are not considering further improvements to resilience. We are also confident that we fully understand the vulnerabilities of our assets and that we take prompt action to rectify any increase in risk.



<sup>&</sup>lt;sup>6</sup> MFT Workshop November 2018 London and Edinburgh (ref 013, 014)

<sup>&</sup>lt;sup>7</sup> Safe and Efficient round table event (ref 089)

## 5 GD2 cross sector issues

## 5.1 Decarbonisation and whole system

The 2050 target of zero-net carbon emissions for the UK will require either a significant reduction of gas usage or the migration to other fuels, such as hydrogen. A reduction in gas usage will require the incentivisation of heat pumps, other innovations or other legislative measures. However, a 10 to 20% overall reduction in annual demand by 2030 will not allow any significant disposal of Transmission assets in GD2 or shortly thereafter. Small-scale injection of up to 20% hydrogen to the gas supply will similarly not permit any down-sizing of Transmission assets and it is not clear, at this time, what part the Transmission system will have in future transportation of hydrogen or carbon dioxide. This uncertainty has led us to our '4Rs' strategy and to propose the minimum level of interventions to ensure the continuation of a safe and reliable network.

The projects and plans put forward in this appendix would not be changed according to different energy scenarios that are discussed in the Energy Futures – Whole Systems appendix (007) as all the projects identified are necessary to manage risk and maintain the integrity of the transmission pipeline during GD2. Innovations developed in GD1 that will benefit our plans in GD2 include the following:

## Immersion tube preheater system

Pressure reduction typically results in reduction in gas temperature through the Joule-Thomson effect of around 0.5°C per 1bar of pressure drop. Sites in Southern typically see pressure reduction of around 36bar, which can mean gas outlet temperatures of -13°C and corresponding component damage, frost ground-heave etc. In Scotland those figures rise to up to 69bar and -30°C respectively. To avoid these impacts, we pre-heat the gas prior to the pressure

reduction.

In GD1, we implemented a new concept in immersion tube preheating – a thermosyphon indirect heating solution. We intend to utilise this technology where possible during the remainder of GD1 and into GD2.

We are also progressing further control optimisation to minimise environmental impacts and a smaller low-cost heating solution, known as ACE (Advanced Condensing Exchanger).

# Figure 5: Performance comparison of traditional water bath heater and immersion tube thermosyphon heater



We are also investigating methods of improving the control of pre-heating to minimise unnecessary energy usage. In the graphs opposite and above, the orange lines show the changes in gas demand while the blue lines show the outlet temperature as provided by the pre-heating. In the lower graphs, temperatures are less stable with overshoot (too much heat) and droop (insufficient heat). With some improved intelligence, more stable outlet temperatures are possible as shown in the upper graph.

## P/11 scanner and defect resolution

Pipeline and pipework defects are inspected and sentenced according to an industry wide procedure, P/11. The inspection process is complex, technical and requires highly competent personnel. In order to undertake these inspections efficiently, we have implemented various innovative inspection techniques, such as a scanner to scan defects and undertaken automated assessment. Also, where remediation is required, other



innovations, such as hot bolting, are in place. We are also developing techniques such as weld deposition.

## 5.2 Resilience (environment, asset, workforce)

Figure 6:	Security

We have transferred all of our pipeline records onto a new asset repository, Synergi Pipeline, which holds both graphical and tabular data.

This system will allow more detailed analysis and input of pipeline segments into NARMs and will ensure that our CBAs give a more accurate indication of risk at a local level. The system will also allow improved identification of risks near pipelines. For example, AC corrosion is caused where a buried pipeline is routed parallel to overhead power cables. The system also allows better mapping of impacts and consequences; for example, where a pipeline is routed in close proximity to

domestic properties.

We also continuously review the various failure modes of our assets. The majority of failures, such as corrosion are predictable. However, some failure modes are less predictable, especially where the onset of the threat is rapid and unforeseen. One such risk is the

impact of flooding and fluvial erosion.

The Scottish Environmental Protection Agency (SEPA) and the Environment Agency (EA) publish graphical flood risk data. We use this data to identify the risk of flooding of our assets and we have already taken mitigating action as appropriate.

In order to mitigate the risk of flooding, we have procured mobile flood prevention measures that can be erected at short notice to protect sites. However, this is ineffective where rapid erosion of river beds and banks can undermine the foundations of a pipeline.

Such risks are material in the Scotland Network, where we have had to divert two sections of pipeline: one at Kincraigie where

## Figure 7: River Tay pipeline exposure



Exposed pipeline 24/04/2014

the river began to erode the river bank by a matter of metres in only a few weeks and another on the River Don, where our pipeline was exposed by rapid erosion of the river bed (each at a cost between £1m and £2m).

It is therefore considered prudent to include a proposal for an uncertainty mechanism around environmental resilience to allow for measures in response to immediate risk of asset failure due to fluvial and pluvial flood risk where the known risk is currently estimated as low. It is understood that a similar volume driver is already in place with National Grid UK Transmission for their GT1 price control, known as the 'Quarry and Loss' reopener. We are proposing a similar arrangement for GDNs in GD2, related to flow risk. More information can be found in section 6.8 of this appendix – Managing Uncertainty.



# 6 GD2 activity breakdown

## 6.1 Approach to GD2

Over the course of GD2 expenditure on Transmission Integrity is expected to be approximately 7% of total expenditure.

Prior to GD1, we commissioned a major site-based inspection of all offtakes and PRSs. This informed our business plans for GD1. In 2015, we further developed this inspection regime with the introduction of management procedure, SGN/PM/CM/4 part 1. The inspection considers every accessible pipe section within a site and includes removal of pipe supports, lagging and other obstructions, where corrosion could hide. The initial inspections undertaken under this regime have been scheduled on the basis of risk taking into account our existing knowledge of the age, condition and configuration of sites. The outputs of the CM/4 inspections undertaken to date have informed our plans for GD2. These outputs are also directly linked to our Monetised Risk targets since asset condition is a key driver for asset health.

We have also fully utilised other means of quantifying asset health. For example, we monitor the instances of telemetered alarms on our key assets. All offtakes and the majority of PRS are monitored in real-time using satellite-based SCADA (supervisor control and data acquisition) systems. Early in GD1 we fully applied the best practice guidance<sup>8</sup> on the classification of faults. We use high and critical priority faults as an indicator of reliability to then inform both our Monetised Risk output and our investment plans. These faults are also monitored as part of a separate secondary deliverable output.

We use all available sources of evidence of asset condition, including faults from our examinations under PSSR 2000. Such faults are designated as PSSR category B, A2 and A1, with A1 constituting immediate danger, while A2 is termed a significant fault. We monitor A1 and A2 faults as part of a separate secondary deliverable output and we also use them to populate our Monetised Risk models.

The Transmission Integrity projects identified within this plan are required to mitigate known reliability and condition-based defects, which are sufficiently serious to negate any possibility of deferral. The intervention planned is the minimum necessary to fully remediate the defect in accordance with our '4Rs' strategy.

The workloads that we are proposing to complete for GD2 cover:

- Offtake investment Typically pre-heating and regulator stream replacement projects, this includes a full site rebuild for Lockerbie
- PRS investment A range of heating, pre-heating, and filter replacement projects, with full site rebuilds at Provan, Airth and Lauder
- Pipeline investment Railway crossing revalidation and CP system upgrades
- Compliance Activity Revalidation and remedial work for Offtakes, PRSs and LTS Pipelines

For Transmission Integrity projects we have identified as named projects each of the sites that we expect to work on in GD2. The largest capital project, in our Scotland network, is the RO2 Dunkeld Diversion which resolves an integrity challenge created by the River Tay. The second largest is the rebuild of Provan PRS.

Our revalidation-based compliance activity includes the following:

**CM/4 inspections and remediation.** The CM/4 procedure ensures that we carry out consistent, periodic assessments of all assets on (>7bar) installations to ensure continued asset integrity and fitness for purpose. The process is aimed at ensuring a detailed level of knowledge is obtained for all sites through data capture to

<sup>&</sup>lt;sup>8</sup> Engineering Equipment and Materials Users Association, EEMUA 191, *Alarm systems: a guide to design, management and procurement* 



identify any defects early for prioritisation in a remediation plan. Investment sought for GD2 will allow for the continuous assessment and remediation of these defects. Costs have been provided on a unit basis for inspections with anticipated remedial work based on historical evidence.

**Pigging of high pressure pipelines.** Below ground assets of a significant length such as pipelines cannot be inspected visually as it is not economic to do so. The use of intelligent 'pigs' has allowed for an economic method of measuring the surface profile of the pipeline wall. Expert analysis is then used to assess this profile data and determine the quantity and nature of the defects. Actual visual inspection can then be targeted to only specific areas of the pipeline as identified by the OLI/1 inspection. It can then be determined whether any remediation is required. To comply with the PSR and PSSR, we will, where possible, inspect all high-pressure pipelines using the magnetic flux leakage in-line inspection tool at frequencies specified by the 'Intervals2' software package. We have set out fixed lengths and unit rates for this.

**Revalidation of high pressure filters and pig traps**. PRSs and offtakes on our network feature at least two high pressure filters. These are typically large pressure vessels with internal filter baskets designed to remove all contaminants larger than 2µm. They must do this while allowing the peak flow at the minimum inlet pressure with minimal differential pressure (≤100mbarg). Consequently, these vessels can be large especially on higher flow sites. We also maintain a large number of pig traps on our network to facilitate internal inspections carried out on pipelines within the LTS. These are high volume pressure vessels that have similar risks to filters. Inspection work is determined at a fixed unit cost.

**Revalidation of water bath heaters.** Network pre-heating is undertaken using water bath heaters (WBHs) that utilise a large burner to pre-heat the inlet gas and counteract the Joule-Thomson effect from the pressure regulators. As a part of our revalidation programme. WBHs are inspected under the examination SGN/PR/MAINT/2004 at least every 10 years utilising specialist techniques. We have an ongoing programme of inspection with defined unit costs.

For each of these validation programmes there will be associated costs of remediation. We have costed such works based on previous experience and have included efficient costs within the GD2 plan.

For named projects, our investment proposals are supported by Investment Decision Packs (including CBAs and EJPs) as required under Ofgem's 'Investment Decision Pack Guidance' of March 2019.

## 6.1(b) Impact of government policy

The workloads within this Transmission Integrity and Compliance plan are the minimum necessary to maintain a safe and reliable system for the duration of GD2 and the immediate future. The relevant CBAs demonstrate that the primary risks associated with Transmission assets relate to safety and security of supply. Government policy in relation to these factors is unlikely to change in the medium term. Government policy in relation to climate change is likely to change in the latter stages of GD2. While methane emissions are not a significant driver in terms of project justifications, a reduction in methane content has been factored into the CBA (see section 6.1(c) Scenarios and sensitivities below).

## 6.1(c) Scenarios and sensitivities

Sensitivities have been applied to the Transmission Integrity CBAs as follows:

- Variations in capex project cost have been applied for the range -10% to +20%. These are considered realistic ranges based on our experience in GD1 and the likely pressures on cost in relation to the procurement of materials and main contracts.
- Variations in methane levels (and therefore environmental impact) have been considered to take account of the anticipated introduction of hydrogen. We have committed to a 'net-zero' carbon network by 2045. In practice that means no methane by that date. Also, while the use of hydrogen in distribution is being actively investigated and hydrogen is currently being introduced into a network for the first time since the conversion to natural gas, it is considered very unlikely that hydrogen will be injected on a wider scale



until GD3. For these reasons, methane levels have been considered in three ranges: aggressive early transition, mid-case and late transition.





The current version of the CBA template, version 4, already acknowledges that methane is estimated to be 28 times more damaging than CO<sub>2</sub>. This figure is taken from the IPCC Fifth Assessment Report published in 2014. Since this figure is derived from the latest science, it is not considered prudent to test for sensitivity in this area.

Sensitivity in the value/cost of carbon is already included within the CBA template with base-case and high-case scenarios mapped out. These sensitivities are considered sufficient in our CBA.

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

The scenarios are summarised as follows:

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

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

The data for CBA used to test the Transmission Integrity Plan has been taken from our<sup>Com</sup> Monetised Risk model. The methodology in the model is entirely consistent with NARMs. Since the methodology and factors used have been forensically assessed, tested and validated, it is not considered appropriate to test for sensitivities. Such factors include number of lives lost, numbers of supplies lost.

## 6.2 GD2 outputs and price control deliverables

Below we separate out each of the projects that we will deliver in GD2 with a brief description, associated cost and summary of the assessment type. Projects have been separated according to offtake, PRS LTS pipelines projects and compliance activity.



These costs are the prime costs with capitalised overheads included and expected efficiency improvements deducted.

#### **Offtake projects**

Project work associated with the NTS offtakes have all been identified in the project annex with the associated description of the project, detailed cost breakdown and CBA. The costs detailed within the following tables are inclusive of efficiencies and overheads.

#### Table 13: Offtake investment summary

Scotland	Project	Notes	Cost (£m)	NARMs	СВА
Lockerbie Offtake	Full site rebuild	Full rebuild of the site to resolve health issues.	1.74	✓	✓
Multiple	Offtake Fabric Upgrades	Minor civil works to ensure safe egress within the sites and adequate building condition.	0.12	×	×
Total			1.86		
Southern	Project	Notes	Cost (£m)	NARMs	СВА
Mappowder	Pre-Heating and Regulator Stream Replacement	Replace failing pre-heating system, slam-shuts and control valves	6.08	$\checkmark$	✓
Winkfield Offtake - System 1 (South East)	Pre-Heating and Regulator Stream Replacement	Replace failing pre-heating system, slam-shuts and control valves	8.23	~	✓
Winkfield Offtake - System 2 (south)	Pre-Heating and Regulator Stream Replacement	Replace failing pre-heating system, slam-shuts and control valves	7.79	$\checkmark$	✓
Total			22.10		

#### **PRS projects**

In GD2 we have retained the focus on PRS from our actual intervention plan in GD1. A summary of each project is given in the table below. The details of each are given in the project appendix. On an individual project level these are typically relatively small projects of £0.5-£2m with the exception of three rebuilds at Provan, Newton Means and Shalford.

#### **Table 14:PRS Investment Summary**

Scotland	Project	Notes	Cost (£m)	NARMs	CBA
Provan PRS	Provan PRS Full Site Rebuild and Above Ground Pipework Rationalisation	Removal of Above Ground Pipework and rationalisation of site. Dramatic reduction in the integrity risk requiring management.	14.41	~	✓
Newton Means and Waterfoot	Combine Newton Mearns and Waterfoot PRS	Combining to a single site – Rebuilding one PRS and decommissioning a second.	8.54	$\checkmark$	✓
Georgetown PRS	Georgetown PRS – Rebuild	Detailed CM/4 inspections have uncovered various integrity issues. A full rebuild is required to address these.	3.39	~	✓
Fairmilehead	Replacement of pressure control systems	Resolve significant integrity issues.	1.79	$\checkmark$	✓
St Andrews PRS	St Andrews PRS, Decommission and Downrate	Some <7barg reinforcement will allow a Pressure Regulating Station requiring major works to be completely decommissioned.	2.56	<b>√</b>	✓
Airth	Full site rebuild	Small PRS with pre-heating issue and failing pressure control equipmen.t	1.23	$\checkmark$	✓
Lauder	Full site rebuild	Small PRS with pre-heating issue and failing pressure control equipment.	1.13	$\checkmark$	✓
Carleith PRS	Carleith PRS Boiler-house Replacement (Both systems)	Boilers suffer from increased failure rate due to Aluminium Heat Exchangers. A replacement is required.	0.83	✓	√



Total			43.76		
Multiple	Process safety uncertainty	Use-it-or-lose-it allowance for unforeseen condition issues.	7.39	×	×
Multiple	Non Routine Filter Repair/Replacement	Allows for replacement of filters required due to discovery of 'crack-like defects'.	0.30	×	×
Granton PRS	Granton PRS Boiler-house Replacement	Boilers suffer from increased failure rate due to Aluminium Heat Exchangers. A replacement is required.	0.68	$\checkmark$	$\checkmark$
Multiple	PRS Fabric Upgrades	Some minor civil works to ensure safe egress within the sites and adequate building condition.	0.45	×	×
Bellshill PRS	Bellshill PRS Decommission and Supply from <7barg	Some <7barg reinforcement will allow the PRS requiring major works to be decommissioned.	0.47	$\checkmark$	×
Aberdeen (Craibstone) PRS	Aberdeen (Craibstone) Boiler- house Replacement	Boilers suffer from increased failure rate due to Aluminium Heat Exchangers. A replacement is required.	0.59	✓	~

Southern	Project	Notes	Cost Estimate (£m)	NARMs	СВА
Aylesham PRS	Boilers and flow and returns	Replace failing pre-heating system in very poor condition.	1.27	✓	✓
Battle PRS - System 1	Heating	Replace failing pre-heating system in very poor condition.	1.08	$\checkmark$	✓
Battle PRS - System 2	Full system rebuild	Replace filtration, pre-heating and pressure control systems due to poor condition and reliability.	2.59	~	✓
Boxhill PRS	Heating	Replace failing pre-heating system in very poor condition.	1.55	$\checkmark$	✓
Braishfield C	Pre-Heating Replacement	Replace failing pre-heating system in very poor condition.	1.23	$\checkmark$	✓
Gillingham	Heating	Replace failing pre-heating system in very poor condition.	0.52	$\checkmark$	×
Godstone PRS	Heating	Replace failing pre-heating system in very poor condition.	1.69	✓	✓
Hillside	Boiler, filters & filter isolation valves.	Replace failing pre-heating system in very poor condition, filters exhibiting life limiting defects and isolation valves that fail to fully operate.	1.87	✓	✓
Hurst Green PRS	Heating	Replace failing pre-heating system in very poor condition.	1.69	✓	✓
Reading A	Filter & HEX Replacement	Replace failing pre-heating system in very poor condition and filters exhibiting life limiting defect.	3.23	✓	✓
Shalford	Full Site Rebuild	Replace filtration, pre-heating and pressure control systems due to poor condition and reliability.	4.24	✓	✓
Shatterling PRS	Heating	Replace failing pre-heating system in very poor condition.	1.43	✓	✓
Smarden PRS	Heating	Replace failing pre-heating system in very poor condition.	1.53	✓	✓
St. Mary Cray 1	Replacement boiler (Turbo expander)	Replace stand-alone boiler package due to age, service hours and deterioration in reliability.	1.97	×	✓
St. Mary Cray 1	Replacement CHP unit	Replace stand-alone CHP package due to age, service hours and deterioration in reliability.	2.47	×	✓
Washington	Pit Lid replacement	Replace failing pit covers to reduce deterioration of below-ground assets.	0.39	×	×



Westerham PRS – System 1	Full Site Rebuild	Replace filtration, pre-heating and pressure reduction systems due to condition and reliability defects.	3.08	✓	√
Westerham PRS – System 2	Full system rebuild	Replace filtration, pre-heating and pressure reduction systems due to condition and reliability defects.	2.63	$\checkmark$	✓
Woking	Pre-Heating and Filters	Replace filtration and pre-heating systems due to condition and reliability defects.	2.32	$\checkmark$	✓
Multiple	Process safety uncertainty	Use-it-or-lose-it allowance for unforeseen condition issues	7.39	×	×
Total			44.17		

#### LTS pipelines projects

LTS pipeline projects in GD2 are dominated by the large Dunkeld diversion which makes up the majority of expenditure at £14.5m. Other large projects include the Hooley pipe crossing, the remainder are less than our internal reporting threshold of £0.5m. The details of the larger projects are given in the project annex, which includes a CBA where appropriate.

#### Table 15:LTS Pipeline Investment Summary

Pipeline	Project	Notes	Cost (£m)	NARMs	СВА
RO2	Dunkeld RO2 Diversion	The River Tay is compromising the integrity of the ground in which this high-pressure pipeline is laid at several points.	25.77	√	✓
Multiple	Marker Posts	Marker posts are being replaced on an ongoing basis due to vandalism, degradation etc. Linewalks are the basis for identifying the scope of replacement in a given year.	0.38	×	×
M04 Milton to Newton Stewart	Converting Pipeline from OLI/4 to OLI/1	Pipework modification and procurement of pig traps will allow a long previously unpiggable pipeline to be inspected internally.	0.41	✓	×
Multiple	Above Ground Crossing Refurbishments	Condition of above ground crossings are being reviewed and remediated for vital protection of above ground assets in the public space.	0.41	×	×
Multiple	River Crossing Remediations	In some instances it is possible to carry out some minor remediation to ensure river bank stabilisation to order to maintain the integrity of the pipeline.	0.30	×	×
Multiple	Sleeve Remediations	The inspection and remediation of 'air-filled' sleeves is part of an ongoing programme that will continue into GD2. (Inspection grouting investigation repair.)	0.30	×	×
Multiple	Groundbed and Transformer Rectifier Replacements	It is a requirement to replace cathodic protection infrastructure on an ongoing basis to maintain the integrity of corrosion inhibiting systems.	0.23	<b>x</b> (1)	×
Multiple	Pig trap replacements	Allows for replacement of filters required due to discovery of 'crack-like defects'.	0.25	×	×
Total			28.06		

#### Total

Note 1: LTS pipelines are included within NARMs. However, cathodic protection is treated as a 'Probability of Consequence' rather than an asset sub-group.

✓ ✓	<b>√</b>
<b>x</b> (1) <b>x</b>	×
	<b>x</b> (1)



#### **Compliance activity**

Compliance investment covers key revalidations that we are obliged to do under legislation (PSSR, PRS etc.). The compliance activities and associated costs are summarised below with more detail provide in the project annex describing the nature of the programme and the basis of the unit costs.

The table below provides a summary of compliance activity by site whether it is an offtake or PRS sites and LTS pipelines.

#### Table 16:Compliance activity summary

Scotland	Project	Notes	Cost (£m)	NARMs	СВА
Offtakes and PRS	Revalidation WBH	Revalidation allowance to carry out 10-yearly inspection/testing of WBH pre-heat systems.	2.64	×	×
	Revalidation Heat Exchangers	Revalidation allowance to carry out 10 -early statutory inspection/testing of heat exchangers	1.63	×	×
	Non-Routine Preheat Repairs	Allowance to carry out repairs on pre-heat systems where additional capex is required.	0.63	×	×
	Filter Revalidations	Revalidation allowance to carry out 12-yearly statutory major inspections of high-pressure filters to comply with PS/3 (PSSR).	0.79	×	×
	WSOE Audits PRS/Offtakes	Revalidation allowance to carry out six-yearly statutory reviews of the WSoE to comply with PSSR.	0.05	×	×
	Drawing Update	Compliance allowance for where additional updates to drawings outside of specific projects require carried out.	0.06	×	×
	CM4 Inspections	Revalidation allowance for carrying out further CM/4 inspections to produce detailed risk profiles of sites.	0.59	×	×
	CM4 Remediation	Allowance for carrying out mechanical remediation as required based on the results of CM/4 inspections. (Mechanical, PRS Offtake and LTS)	2.14	<b>x</b> (1)	×
	CM4 Remediation	Allowance for carrying out civil remediation as required based on the results of CM/4 inspections (Civil, PRS Offtake and LTS)	0.63	×	×
	CM4 Data Base	Revalidation allowance for the continued development and technical support of the CM/4 Database.	0.14	×	×
	CM4 Extreme Defect Resolution	Allowance for where a critical repair is required based on extreme damage. (CM4 Emergency Work)	0.63	×	×
	CM/4 Driven Painting of Sites	Allowance to remediate coating condition on sites following the remediation of other defects.	2.26	<b>x</b> (1)	×
	Total Offtakes and	PRS	12.18		
LTS Pipelines	Pig Trap Revalidations	Revalidation allowance to carry out 12-yearly statutory major inspections of high-pressure pig traps to comply with PS/3 (PSSR).	0.88	×	×
	OLI/1s including feature investigation	Revalidation allowance to carry out statutory internal inspections through the means of pigging. This is to comply with PS/3 (PSSR).	4.90	×	×
	AC/DC Current Monitoring and Mitigation	Allowance to carry out monitoring and mitigation as required from AC/DC interference to Cathodic Protection Systems.	1.76	<b>x</b> (2)	×
	Total LTS		7.54		
Total Scotla	nd		19.72		
Southern	Project	Notes	Cost (£m)	NARMs	СВА
Offtakes and PRS	CM4 Inspections	Revalidation – 110 systems @ £15K each	2.09	×	×
	CM4 Remedial work	Remediation of defects found during CM/4. Examples include stud bolt replacement, pilot replacement, Clips/brackets.	0.63	<b>x</b> (1)	×



	Major		F 08	~	~
	Revalidations	РЗЭК	5.08	~	~
	Painting	Mostly driven by CM4 inspection output.	2.54	<b>x</b> (1)	×
	Civil works	Mostly driven by CM4 inspection output.	0.63	×	×
	Total Offtakes and	d PRS	10.98		
LTS	OLI	Revalidation - 38 OLI inspections. Including investigations.	8.50	×	×
Pipelines	Pipeline Marker Posts	Output of TD1 surveys and fortnightly helicopter flights.	1.02	<b>x</b> (2)	×
	P086 AC Interference	Install zinc ribbon	0.98	<b>x</b> (2)	×
	AC/DC interference	Cathodic protection mitigation (various)	1.30	<b>x</b> (2)	×
	Rail bonds	Remediate rail bonds	0.49	<b>x</b> (2)	×
	EI130	50 to be completed @ £12k each remediation of issues found on vent and sealant lines associated with SEI EI130.	0.76	*	×
	Total LTS		13.04		
			24.02		

**Total Southern** 

Painting and other remedials of offtakes and PRS may be applicable to NARMs where the intervention is undertaken as part of the full refurbishment of the site/system. However, these interventions are part of a general programme and cannot be included within targets.

LTS Pipelines are included within NARMs. However, cathodic protection (including zinc ribbon to prevent AC corrosion) and pipeline markers are treated as a 'Probability of Consequence' rather than an asset sub-group.

These projects and the corresponding phasing of expenditure have been detailed in tab 3.01 of the BPDTs for both Southern and Scotland Networks. Tab 3.01 of the BPDT includes projects relating to the following, which are not detailed within the Transmission Integrity and Compliance plan and are detailed elsewhere:

- Capacity management (growth),
- Electrical and Instrumentation
- Scottish Independent Undertakings

A breakdown of these entries are detailed in 6.2.1 and 6.2.2.

## Offtake and PRS Site Security

Security



	Sec	curity		
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## 6.2.1 Southern Network

The following is a breakdown of the projects and annual forecast expenditures included within tab 3.01 of the BPDT:

TRANSMIS	MISSION INTEGRITY AND COMPLIANCE								
ASSET GROUP	CAT.	WORK DESCRIPTION	2022	2023	2024	2025	2026	TOTALS	
		HOOLEY PIPE BRIDGE – REFURBISHMENT	0.37	1.97	0.00	0.00	0.00	2.33	
		CP SYSTEM UPGRADE	0.00	0.30	0.00	0.31	0.00	0.61	
		OLI	1.75	1.63	1.65	1.65	1.83	8.50	
	NAMED	PIPELINE MARKER POSTS	0.21	0.19	0.20	0.20	0.22	1.02	
		P086 AC INTERFERENCE	0.00	0.49	0.00	0.49	0.00	0.98	
		AC/DC INTERFERENCE	0.00	0.00	0.00	0.62	0.68	1.30	
ES		TOTAL	2.32	4.58	1.84	3.27	2.73	14.74	
ELIN		RAIL BONDS	0.00	0.49	0.00	0.00	0.00	0.49	
BIIPE	< £0.5M	EI130	0.16	0.15	0.15	0.15	0.16	0.76	
LTS		TOTAL	0.16	0.63	0.15	0.15	0.16	1.25	
		MAPPOWDER OFFTAKE	0.26	0.42	1.81	3.33	0.25	6.08	
		WINKFIELD OFFTAKE – SYSTEM 1 (SOUTH EAST)	0.33	1.82	4.91	1.17	0.00	8.23	
	NAIVIED	WINKFIELD OFFTAKE – SYSTEM 2 (SOUTH)	0.33	1.82	2.46	2.78	0.41	7.79	
ES		TOTAL	0.91	4.07	9.18	7.28	0.66	22.10	
TAK	< £0.5M	NONE						0.00	
OFFT		TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	
		AYLESHAM PRS	0.00	0.00	0.15	0.42	0.70	1.27	
		BATTLE PRS – SYSTEM 1	0.14	0.37	0.57	0.00	0.00	1.08	
		BATTLE PRS – SYSTEM 2	0.46	1.58	0.55	0.00	0.00	2.59	
		BOXHILL PRS	0.57	0.98	0.00	0.00	0.00	1.55	
		BRAISHFIELD C PRS	0.00	0.12	0.31	0.80	0.00	1.23	
		GILLINGHAM PRS	0.52	0.00	0.00	0.00	0.00	0.52	
		GODSTONE PRS	0.00	0.00	0.20	0.56	0.93	1.69	
		HILLSIDE PRS	0.25	0.65	0.98	0.00	0.00	1.87	
		HURST GREEN PRS	0.00	0.00	0.20	0.56	0.93	1.69	
		READING A PRS	0.43	1.11	1.69	0.00	0.00	3.23	
	NAMED	SHALFORD PRS	0.00	0.52	1.48	2.23	0.00	4.24	
	NAIVIED	SHATTERLING PRS	0.00	0.00	0.17	0.47	0.79	1.43	
		SMARDEN PRS	0.20	0.53	0.80	0.00	0.00	1.53	
		ST. MARY CRAY 1 – BOILER	0.00	0.00	0.25	1.73	0.00	1.97	
		ST. MARY CRAY 1 – CHP UNIT	0.00	0.00	0.25	2.22	0.00	2.47	
		WESTERHAM PRS – SYSTEM 1	0.33	0.91	1.84	0.00	0.00	3.08	
		WESTERHAM PRS – SYSTEM 2	0.33	0.91	0.31	1.09	0.00	2.63	
		WOKING PRS	0.00	0.00	0.27	0.78	1.27	2.32	
		EAST MORDEN PRS (CAPACITY) <sup>(1)</sup>	0.59	1.55	2.35	0.00	0.00	4.49	
		WAVENDON PRS (CAPACITY) <sup>(1)</sup>	0.57	1.49	2.26	0.00	0.00	4.31	
		USE-IT-OR-LOSE-IT UNCERTAINTY ALLOWANCE	1.49	1.49	1.48	1.47	1.46	7.39	
PRS		CM/4 INSPECTIONS	0.43	0.40	0.41	0.41	0.45	2.09	

Table 19: Summary of annual forecast expenditure within tab 3.01 of the BPDT (Southern)



		CM/4 REMEDIALS	0.13	0.12	0.12	0.12	0.14	0.63
		MAJOR REVALIDATIONS (FILTERS, PRE-HEATING)	1.04	0.97	0.98	0.99	1.09	5.08
		PAINTING	0.52	0.49	0.49	0.49	0.55	2.54
		CIVIL WORKS	0.13	0.12	0.12	0.12	0.14	0.63
		TOTAL	8.14	14.30	18.21	14.47	8.44	63.56
	< CO EM	WASHINGTON PRS - PIT COVER REPLACEMENT	0.39	0.00	0.00	0.00	0.00	0.39
	< £0.5IVI	TOTAL	0.39	0.00	0.00	0.00	0.00	0.39
GRAND TO	TALS		11.92	23.58	29.37	25.16	11.99	102.03

These projects are growth related projects detailed within the separate Capacity Management appendix.

The following highlights the E&I expenditure listed in the separate Electrical and Instrumentation appendix, but included within tab 3.01 of the BPDT:

#### Table 20:E&I costs within tab 3.01 of the BPDT

Electrical and Instrumentation										
Asset Group	Cat.	Work description	2022	2023	2024	2025	2026	Totals		
		Telemetry Upgrades (2 offtakes)	0.03	0.02	0.02	0.02	0.03	0.13		
		Metering Uncertainty Programme (1 site)	0.05	0.05	0.05	0.05	0.05	0.25		
	Named	E&I Upgrade Programme (2 sites)	0.15	0.14	0.14	0.14	0.15	0.72		
		ICMDL	1.22	0.79	0.79	0.80	0.88	4.47		
		Total	1.45	1.00	1.01	1.01	1.11	5.57		
akes	< £0.5m	Various	0.28	0.26	0.26	0.26	0.29	1.34		
Offt		Total	0.28	0.26	0.26	0.26	0.29	1.34		
	Newsed	Telemetry Upgrade (82 PRS)	0.86	0.79	0.80	0.81	0.89	4.15		
		Non-telemetered Pre-heating sites (14 sites)	0.32	0.30	0.30	0.30	0.33	1.54		
		Cathodic Protection T/R Upgrades (40)	0.14	0.13	0.13	0.13	0.14	0.67		
	Nameu	E&I Upgrade Programme (23 sites)	1.05	0.97	0.98	0.98	1.09	5.07		
		E&I Minor Works	0.30	0.28	0.28	0.28	0.31	1.46		
		Total	2.66	2.47	2.49	2.50	2.76	12.88		
	< £0 Em	Various	0.23	0.22	0.22	0.22	0.24	1.13		
PRS	< £0.5m	Total	0.23	0.22	0.22	0.22	0.24	1.13		
Grand Totals			4.61	3.94	3.98	3.99	4.40	20.92		

## 6.2.2 Scotland Network

The following is a breakdown of the projects and annual forecast expenditures included within tab 3.01 of the BPDT:

	Table 21:Summar	y of annual forec	ast expenditure	e within tab 3.01	of the BPDT	(Scotland)
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Transmission Integrity and Compliance										
Asset Group	capex type	Cat.	Work description	2022	2023	2024	2025	2026	Totals	
	Reinf <sup>1</sup> ment Named	Named	T8: Pitcairngreen to Huntingtower - R04 and R05 <sup>(1)</sup>	2.07	3.99	0.64	0.00	0.00	6.71	
			Total	2.07	3.99	0.64	0.00	0.00	6.71	
lines		RO2 Dunkeld	0.73	5.19	9.38	10.48	0.00	25.77		
Pipel		Named	Total	0.73	5.19	9.38	10.48	0.00	25.77	
LTS	Other	Named	Pig Trap Revalidations	0.18	0.17	0.16	0.18	0.19	0.88	



				0.00	0.04	4 00	4 07	4.00
		OLI/1s including feature investigation	0.98	0.93	0.91	1.00	1.07	4.90
		Mitigation	0.35	0.33	0.33	0.36	0.39	1.76
		Total	1.51	1.43	1.41	1.54	1.65	7.54
		Pipeline marker posts	0.08	0.07	0.07	0.08	0.08	0.38
		M04 Milton to Newton Stewart	0.08	0.08	0.08	0.08	0.09	0.41
		Above Ground Crossings	0.08	0.08	0.08	0.08	0.09	0.41
	< CO 5	River Crossings	0.06	0.06	0.06	0.06	0.07	0.30
	< £0.5m	Pipeline sleeves	0.06	0.06	0.06	0.06	0.07	0.30
		CP System Upgrade	0.05	0.04	0.04	0.05	0.05	0.23
		Multiple	0.00	0.00	0.12	0.00	0.14	0.25
		Total	0.41	0.39	0.50	0.42	0.58	2.29
	Nemed	Lockerbie Offtake	1.34	0.39	0.00	0.00	0.00	1.74
Offtakes	Nameo	Total	1.34	0.39	0.00	0.00	0.00	1.74
Untakes	< 60 Em	Offtake Fabric Upgrades	0.00	0.06	0.00	0.06	0.00	0.12
	< E0.5III	Total	0.00	0.06	0.00	0.06	0.00	0.12
		Provan PRS	0.00	4.17	8.44	1.80	0.00	14.41
		Newton Means and Waterfoot PRS	0.00	0.00	0.76	2.16	5.61	8.54
		Georgetown PRS	0.25	0.87	2.14	0.13	0.00	3.39
		Fairmilehead	0.00	0.52	1.02	0.24	0.00	1.79
		St Andrews PRS	0.00	0.00	0.69	1.63	0.23	2.56
		Airth	1.23	0.00	0.00	0.00	0.00	1.23
		Lauder	1.13	0.00	0.00	0.00	0.00	1.13
		Carleith PRS	0.25	0.48	0.11	0.00	0.00	0.83
		Aberdeen (Craibstone) PRS	0.00	0.19	0.35	0.05	0.00	0.59
		Granton	0.00	0.20	0.41	0.06	0.00	0.68
		Dreghorn PRS <sup>(1)</sup>	0.75	1.43	0.23	0.00	0.00	2.42
		Tranent PRS <sup>(1)</sup>	0.88	1.67	0.28	0.00	0.00	2.83
		Edinburgh South East Wedge <sup>(1)</sup>	0.00	2.77	0.00	0.00	0.00	2.77
	Named	Use it or lose it Process safety allowance	1.49	1.49	1.48	1.47	1.46	7.39
PRS		Revalidation WBH	0.53	0.50	0.49	0.54	0.58	2.64
		Revalidation Heat Exchangers	0.33	0.31	0.30	0.33	0.36	1.63
		Non-Routine Preheat Repairs	0.13	0.12	0.12	0.13	0.14	0.63
		Filter Revalidations	0.16	0.15	0.15	0.16	0.17	0.79
		CM4 Inspections	0.12	0.11	0.11	0.12	0.13	0.59
		CM4 Remediation Mechanical, PRS Offtake and LTS	0.43	0.40	0.40	0.44	0.47	2.14
		CM4 Remediation Civil, PRS Offtake and LTS	0.13	0.12	0.12	0.13	0.14	0.63
		CM4 Extreme Defect Resolution (CM4 Emergency Work)	0.13	0.12	0.12	0.13	0.14	0.63
		CM/4 Driven Painting of Sites	0.45	0.43	0.42	0.46	0.50	2.26
		Total	8.37	16.05	18.14	9.99	9.93	62.48
		Bellshill PRS	0.13	0.24	0.11	0.00	0.00	0.47
	< £0.5m	PRS Fabric Upgrades	0.09	0.09	0.08	0.09	0.10	0.45



CM4 Data Base         0.03         0.03         0.03         0.03           Total         0.33         0.43         0.29         0.21	0.03 0.1 0.22 1.4	14 <b>17</b>
CM4 Data Base 0.03 0.03 0.03 0.03	0.03 0.1	14
	0.00	1.4
Drawing Update 0.01 0.01 0.01 0.01	0.01 0.0	06
WSOE Audits PRS/Offtakes 0.01 0.01 0.01 0.01	0.01 0.0	)5
Filter Repair/Replacement 0.06 0.06 0.06 0.06	0.07 0.3	30

Note 1: These projects are growth related projects detailed within the separate Capacity Management

appendix. The following highlights the E&I expenditure listed in the separate Electrical and Instrumentation

#### appendix, but included within tab 3.01 of the BPDT:

## Table 22:E&I costs within tab 3.01 of the BPDT

Electrical and Instrumentation										
Asset Group	Cat.	Work description	2022	2023	2024	2025	2026	Totals		
		Telemetry Upgrades (8 offtakes)	0.10	0.10	0.09	0.10	0.11	0.50		
		Metering Uncertainty Programme (6 sites)	0.83	0.79	0.78	0.85	0.91	4.15		
	Named	E&I Upgrade Programme (5 sites)	0.31	0.30	0.29	0.32	0.34	1.56		
		ICMDL	0.91	0.52	0.51	0.55	0.59	3.07		
akes		Total	2.15	1.70	1.67	1.83	1.95	9.29		
	< £0.5m	Various	0.23	0.22	0.22	0.24	0.25	1.17		
Offt		Total	0.23	0.22	0.22	0.24	0.25	1.17		
		Telemetry Upgrade (73 PRS')	0.73	0.69	0.68	0.75	0.80	3.65		
	Named	E&I Upgrade Programme (4 sites)	0.16	0.15	0.15	0.17	0.18	0.81		
		E&I Minor Works (~15 sites)	0.10	0.10	0.09	0.10	0.11	0.50		
		Cathodic Protection T/R Upgrades (15)	0.05	0.05	0.05	0.05	0.05	0.25		
		Total	1.05	0.99	0.97	1.07	1.14	5.22		
	1 CO E	Various	0.12	0.11	0.11	0.12	0.13	0.59		
PRS	< ±0.5m	Total	0.12	0.11	0.11	0.12	0.13	0.59		
Grand Totals			3.55	3.02	2.97	3.25	3.47	16.27		

The following highlights expenditure listed in the separate SIU appendix (017), but included within tab 3.01 of the BPDT:

#### Table 23:SIU costs within tab 3.01 of the BPDT

SIU								
Asset Group	Cat.	Work description	2022	2023	2024	2025	2026	Totals
		Replace atmospheric vaporisers	0.19	0.18	0.18	0.20	0.21	0.96
		Electrical, instrumentation, control upgrade and telemetry	0.21	0.20	0.20	0.21	0.23	1.05
		Replacement vessels due to condition	0.25	0.24	0.23	0.26	0.27	1.25
Name	Named	Hot water vaporiser replacement	0.31	0.30	0.30	0.32	0.34	1.57
		Revalidate/replace road fleet	0.94	0.89	0.88	0.96	1.02	4.69
		Fleet, road tankers and ISO component upgrades	0.31	0.30	0.29	0.32	0.34	1.56
		Total	2.21	2.11	2.08	2.27	2.41	11.08
	< CO Em	Various	0.80	0.76	0.75	0.81	0.87	3.88
PRS	< <u>10</u> .5111	Total	0.80	0.76	0.75	0.81	0.87	3.88
Grand Totals			3.01	2.87	2.83	3.08	3.28	15.07



## 6.3 Bespoke outputs

It is anticipated that the NOMs output as currently defined within Special Condition 4G of the gas transporters' licence, which also form the basis of the NARMs methodology for GD2, and the associated penalty and reward mechanism as currently defined by Special Condition 4H, both of which are subject to amendment and redefinition by Ofgem, will allow the benefits of the Transmission Integrity workload to be monitored. Therefore, no additional bespoke outputs are considered necessary.

The existing NTS Capacity Incentive mechanism relates to the throughput of the offtakes into the LTS, which is guaranteed by a number of interventions planned within this appendix. It is understood that this incentive is currently under review and likely to be modified prior to the start of GD2.

## 6.4 Investment in existing assets – CBA and NARMs

Ofgem has suggested the following categorisation in terms of funding justification and reporting under the NARMs methodology where assets categorised according to whether they are covered by monetised risk or not, and of those covered by monetised risk, whether their funding justification is provided through the NARMs methodology.

In general, the interventions identified within this plan comprise type A Monetised Risk – all NARMS related assets. The majority of named Transmission Integrity projects will be fully justified by the outputs of the NARMs methodology and are classified as A1, both in terms of CBA and reporting. There are isolated instances



#### Figure 9: Reporting and justification methodology

of associated assets, such as cathodic protection systems for steel pipelines, where the primary asset, the pipeline, is a NARMs related asset, but the sub-system is not separately identified, and no interventions have been identified within NARMs. Such interventions are classified as A2.

Compliance activities are generally undertaken on NARMs related assets but are driven by legislative requirements and do not improve health or reduce criticality. As such, these interventions are classified as A3.

There are two interventions on

non-NARMs related assets that are classified as type B. These projects do have EJPs and associated CBA.

All relevant interventions detailed within this plan are justified through improvements in condition or reliability and as such an Investment Decision Pack has been developed, including a CBA and EJP.

It is anticipated that NARMs will be fully effective in monitoring the delivery of this workplan and also to provide targets for delivery ensuring benefits to customers are fully realised.

Discussions are ongoing regarding the format of the NARMs targets for GD2. Ofgem are minded to develop targets that consider long-term risk – that is the cumulative risk over the life of the intervention. Further definition of the parameters of this target is required; for example, what is the agreed lifespan of specific interventions. It is therefore expected that the targets for risk reduction will only be finalised after final



submission of this Business Plan. They will, however, be consistent with the methodology that is already accepted by all parties. The GD1 targets considered the change (delta) in total risk in the final year of the price control period (2021). The equivalent figures for GD2 are as follows:

	2021	2026		
Asset Category	Without Intervention	Without intervention	With intervention	Delta
LTS Pipelines (Piggable)	37.93	38.03	38.03	0.00
LTS Pipelines (Non Piggable)	1.19	1.20	1.20	0.00
Offtake Filters	0.82	1.06	1.06	0.00
PRS Filters	24.69	33.54	28.73	4.81
Offtake Slamshut/Regulators	1.42	1.76	0.88	0.88
PRS Slamshut/Regulators	10.50	10.93	10.02	0.91
Offtake Pre-heating	6.16	13.47	5.45	8.02
PRS Pre-heating	8.88	19.58	9.99	9.60
Odourisation and Metering	2.33	3.10	3.10	0.00
Totals	93.93	122.68	98.46	24.22

#### Table 24: GD2 monetised risk values for Southern Network

#### Table 25:GD2 monetised risk values for Scotland Network

Asset Category	2021	2026		
	Without Intervention	Without intervention	With intervention	Delta
LTS Pipelines (Piggable)	19.68	19.72	19.72	0.00
LTS Pipelines (Non Piggable)	9.66	9.75	3.10	6.65
Offtake Filters	0.52	0.53	0.53	0.00
PRS Filters	6.63	7.24	6.00	1.24
Offtake Slamshut/Regulators	0.96	1.00	0.93	0.08
PRS Slamshut/Regulators	8.35	9.00	7.55	1.45
Offtake Pre-heating	2.09	2.11	2.11	0.00
PRS Pre-heating	8.37	12.76	10.73	2.03
Odourisation and Metering	2.79	3.49	3.49	0.00
Totals	59.04	65.60	54.16	11.45

All values in £m. Odorisation and metering assets are detailed within the separate E&I appendix.

In GD1, a penalty and reward mechanism, as defined under Special Condition 4H, provides the appropriate incentives for the distribution networks to either deliver the plan or to conduct risk trading in such a way that the equivalent risk reduction is achieved. It is fully expected that an equivalent mechanism will be developed for GD2, although it is likely that this will focus more on penalties for under-performance.

## 6.5 Engineering Justification Papers

In terms of engineering justification, Ofgem has proposed the following model to differentiate between 'major' projects requiring justification in accordance with Ofgem's guidance, known as Appendix A, and 'asset health' projects justified in accordance with the guidance, known as Appendix B.



#### Figure 10: Guidance for engineering justification

Major Project	Asset Health				
<ul> <li>Named scheme</li> <li>'Capex' multi-discipline</li> <li>Geo-defined scope</li> <li>Delivers new service</li> <li>New design</li> <li>Higher risk spend</li> </ul>	<ul> <li>Spend on one asset class</li> <li>Single / limited discipline</li> <li>Geo-diverse</li> <li>No change to plant</li> <li>Similar / same scope</li> <li>Routine spend</li> </ul>				
Bespoke estimate	tainty Unit costs /				

The engineering justification for the majority of Transmission Integrity projects has been classified as 'asset health' and has been drafted in accordance with Appendix B since they are related to one asset class, are of limited discipline, relate solely to refurbishment or replacement of plant and have limited uncertainty.

Two projects – the largest in terms of monetary spend – have much greater uncertainty and therefore the expenditure

is of higher risk and involve new designs. These projects are the diversion of pipeline R02 at Dunkeld and the proposed works at Provan PRS.

The following EJPs have been prepared in support of the GD2 Business Plan:

#### Table 26: Index of EJP – Southern Network

Southern -	- Integrity Work				
Asset Group	Project/Programme	Value £m	NPV (£m)	CBA Payback	Engineering Justification Paper – Reference
	Mappowder	£6.08m	325.8	1	SGN Trans – 001Mapp – EJP Dec19
Offtakes	Winkfield – System 1	£8.23m	12.9	18	SGN Trans – 002Wink1 - EJP Dec19
	Winkfield – System 2	£7.79m	11.8	17	SGN Trans – 003Wink2 – EJP Dec19
	Aylesham	£1.27m	-0.9	50	SGN Trans – 004Ayle – EJP Dec19
	Battle – System 1	£1.08m	17.7	3	SGN Trans – 005Batt1 – EJP Dec19
	Battle – System 2	£2.59m	85	1	SGN Trans – 006Batt2 – EJP Dec19
	Boxhill	£1.55m	4.8	9	SGN Trans – 007Boxh – EJP Dec19
	Braishfield C	£1.23m	21.4	4	SGN Trans – 008Brai – EJP Dec19
	Gillingham	£0.52m	N/A	N/A	N/A
	Godstone	£1.69m	1.4	21	SGN Trans – 009Gods – EJP Dec19
	Hillside	£1.87m	20	5	SGN Trans – 010Hill – EJP Dec19
	Hurst Green	£1.69m	3.7	15	SGN Trans – 011Hurs – EJP Dec19
PRS	Reading A	£3.23m	6.4	12	SGN Trans – 012Read – EJP Dec19
	Shalford	£4.24m	62.3	2	SGN Trans – 013Shal – EJP Dec19
	Shatterling	£1.43m	4	14	SGN Trans – 014Shat – EJP Dec19
	Smarden	£1.53m	1.4	20	SGN Trans – 015Smar – EJP Dec19
	SMC 1 – Boiler Replacement	£1.97m		4	
	SMC 1 – CHP Replacement	£2.47m	0	4	SOM HAIR - OTOSMICI - EJA DECTA
	Washington	£0.39m	N/A	N/A	N/A
	Westerham – System 1	£3.08m	11	9	SGN Trans – 017West1 – EJP Dec19
	Westerham – System 2	£2.63m	18.3	6	SGN Trans – 018West2 – EJP Dec19
	Woking	£2.32m	101.5	0	SGN Trans – 019 Woki – EJP Dec19
Dipolines	Hooley Pipe Bridge	£2.33m	8.7	9	SGN Trans – 020Hool – EJP Dec19
ripennes	CP System Upgrade	£0.61m	N/A	N/A	N/A
	Total	£61.82m			



#### Table 27: Index of EJP – Scotland network

Scotland -	- Integrity Work				
Asset Group	Project/Programme	Value £m	NPV (£m)	CBA Payback	Engineering Justification Paper – Reference
Offtakes	Lockerbie Rebuild	£1.74.m	8.4	15	SGN Trans – 021Lock – EJP Dec19
Ontakes	Fabric Upgrades	£0.12m	N/A	N/A	N/A
	Provan rebuild and pipework rationalisation	£14.41m	10.3/12.9	17/17	SGN Trans – 022Prov – EJP Dec19
	Newton Means/Waterfoot PRS	£8.54m	24.4 /27.3	9/10	SGN Trans – 023Newt – EJP Dec19
	Georgetown Rebuild	£3.39m	16	15	SGN Trans – 024Geor – EJP Dec19
	Fairmilehead	£1.79m	10/7	8/10	SGN Trans – 025Fair – EJP Dec19
	St Andrews	£2.56m	17.9	8	SGN Trans – 026StAn – EJP – Dec19
DDC	Airth	£1.23m	29	2	SGN Trans – 027Airt – EJP Dec 19
FNJ	Lauder	£1.13m	7.5	13	SGN Trans – 027Airt – EJP Dec 19
	Carleith	£0.83m	30/1.3	1/7	SGN Trans – 028Carl – EJP Dec19
	Aberdeen (Craibstone)	£0.59m	0.2	21	SGN Trans – 028Carl – EJP Dec19
	Bellshill	£0.47m	N/A	N/A	N/A
	Fabric Upgrades	£0.45m	N/A	N/A	N/A
	Granton	£0.68m	0.2/0.1	15/24	SGN Trans – 028Carl – EJP Dec19
	Filter Repair/Replacements	£0.30m	N/A	N/A	N/A
	Dunkeld Diversion	£25.77m	98.7	4	SGN Trans – 029Dunk – EJP Dec19
	Pipeline Marker Posts	£0.38m	N/A	N/A	N/A
	Milton to Newton Stewart – OLI/4 to OLI/1	£0.41m	N/A	N/A	N/A
Pipelines	Refurb Above Ground Crossings	£0.41m	N/A	N/A	N/A
P	River Crossings – Remediation	£0.30m	N/A	N/A	N/A
	remediation	£0.30m	N/A	N/A	N/A
	CP Upgrades	£0.23m	N/A	N/A	N/A
	Pig Trap Replacements	£0.25m	N/A	N/A	N/A
	Total	£66.28m			

CBA associated with these EJP are similarly named (e.g. SGN Trans – 029Dunk – CBA Dec19

EJP titled 027Airt and 028Carl consider multiple sites as detailed above.

A common EJP for compliance projects has been drafted and is titled SGN Trans – 031Comp - EJP Dec19.

Payback period are based on 0% Capitalisation rate

For NARMs related assets, the CBA has been generated directly from the NARMs methodology. For some specific sub-groups, the CBA has been derived from alternative mechanisms.

In GD1, we migrated our NOMs data into a fully functioning investment planning tool, Commercial Confidentiality
Our reporting for NOMs in GD1, for NARMs in GD2 and the data for our CBAs for Transmission<sup>Commercial Confidentiality</sup>

The projects for GD2 have been conceived through a technical assessment of the reliability and or condition defects found through inspection. The consideration of reliability and condition reflects the learning from NOMs and NARMs regarding the appropriate drivers for intervention. The output of NOMs/NARMs has been directly input into the CBA models and the time to a positive return on investment has been determined. In



general, a positive return within 20 years is expected with the majority of projects returning a positive outcome much sooner due to the criticality of the assets. In isolated cases, a longer timeframe to a positive payback has forced a review of the project. Only where the project has been deemed the minimum requirement to maintain our licence obligations to maintain gas supplies has the project been retained within the plan.

We are generally confident that the NARMs methodology covers all of the major risks associated with Transmission assets. In one case, an overhead crossing of a major rail route into London by an LTS pipeline, we have considered impacts to rail commuters, which are not currently covered by NARMs.

The majority of failure modes within NARMs are designated 'repairable failures' as opposed to end-of-life failures, where the maximum number of failures would be one. As such, there is no maximum for the number of failures and deterioration can increase these rates unchecked. In practice, however, the number of failures will be limited by factors such as 'time to repair', periods of observation/monitoring and the short-term effects of the repairs undertaken. The current version of NARMs Methodology (V3.2) can, in some instances, provide unrealistic long-term benefit. The failure rates calculated are based on exponential degradation which increases significantly over the long-term. To realistically assess the CBA produced by NARMs, the values used in the CBA calculation for Transmission assets are capped based on engineering judgement.

The failure nodes for transmission assets are grouped into the following categories:

- Catastrophic Failure: End-of-life failure leading to an unconstrained Release of Gas.
- System Failure: failure leading to lack of control such as:
  - o High Outlet Pressure
  - o High Outlet Temperature
- General Failure: minor issues not leading major consequence.

#### **Table 28: Capped failure rates**

Failure Node	Failure Category	Cap (number of failures)
Preheating – Release of Gas	Catastrophic Failure	1
Preheating – General Failure	General Failure	10
Preheating – High Outlet Temp	System Failure	5
Preheating – Low Outlet Temp	System Failure	5
PC&F – Release of Gas	Catastrophic Failure	1
PC&F – General failure	General Failure	10
PC&F – High Outlet Pressure	System Failure	5
PC&F – Low Outlet Pressure	System Failure	5
O&M – Release of gas	Catastrophic Failure	1
O&M – General failure	General Failure	10
O&M – H_odourant	System Failure	5
O&M – L_odourant	System Failure	5
O&M – Release of odourant	System Failure	5
O&M – Over meter reading	System Failure	5
O&M – Under meter reading	System Failure	5

The capping shown above eliminates any unrealistic impacts of exponential degradation which an asset would never see in practice. These capped failures refine the CBA to more realistic output in accordance with the asset management principles.



## 6.6 Investment in new assets

This appendix covers the refurbishment, replacement and diversion of existing assets to manage and improve asset health. New assets for localised increases in customer demand are detailed within a separate Capacity Management appendix (018). No new assets are proposed to improve resilience of gas supply security.

## 6.7 Cost efficiency

Every Transmission Integrity project has been identified and scoped based on the results of inspections and surveys. These are detailed in the project annex accordingly.

For each of the identified named projects a feasibility study including conceptual design has been completed by external design houses that have been used in

GD1 and that have local knowledge and experience. For smaller projects actual costs of delivery in GD1 were reviewed, extrapolated and compared to those generated for GD2.

It should be noted that offtakes, PRS and LTS pipelines vary greatly in size. Thus, any comparison in costs for full or partial rebuilds must take account of the full scope of work.

Our procurement and contracting strategy for all activities is detailed within our Procurement and Native Competition appendix (010). A section covers the strategy for Major (Transmission) projects and highlights the following:

- In GD1 we contracted outside of existing framework contracts to develop the market.
- Currently, all business-critical framework agreements are being retendered partly to ensure a compliant platform for GD2 and to deliver cost efficient rates.
- A bespoke framework contract for skid units has been developed that reduces timescales while maintaining competitive rates.
- Each project is assessed for risk, which is then apportioned either to the contractor or SGN based on risk scale and costs.

In general, all major project activities, such as procurement of works contracts will be competitively procured via specific tendering exercises using, in some cases, agreed framework contractors. Some packages of work, such as project design, are procured under framework contracts. These arrangements were successfully deployed in GD1. Cost estimates for GD2 are based on the outcomes of similar exercises in GD1. There have been some inflationary pressures on tendered rates in GD1 due to the limited availability of contractors. It is considered that similar pressures will be evident in GD2, especially since workload levels are similar and there is some uncertainty about external pressures on contractors, such as the HS2 rail project. On this basis, it is expected that costs will reflect performance in GD1.

All of the materials and works required to deliver this plan will be obtained either by individual or programme tender. Suppliers are not regionally focused and there is widespread movement of resources. As such, there are few, if any, regional differences in costs.

For the purposes of the business plan submission on 9 December 2019 we have made our current forecast on the following basis:

That all prices are expressed in 2018/19 values.

That cost pressures between 2018/19 and the start of the price control 2021/22 will be equal to CPI(h).



## 6.8 Managing uncertainty

## 6.8.1 Volume drivers

Given the uncertainties surrounding climate change and the impact of extreme weather events on the existing asset base, we propose a 'risk mitigation measures' volume driver in response to immediate risk of asset failure due to fluvial and pluvial flood risk. We anticipate that this will be similar to the volume driver that is already in place with National Grid UK Transmission for their GT1 price control period, known as the 'Quarry and Loss' reopener.

## Uncertainty mechanism: environmental resilience

To date we have generated at least two projects in GD1 at a cost of between £1.5m and £2m each. In both instances the rate at which the erosion occurred, and location of the erosion could not have been anticipated. 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 Distribution Integrity and Governors appendix (012) where the distribution network is faced with similar challenges and we provide an example from the South Esk River near Brechin.

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 may also occur in southern.

In addition to the expenditure of around £3.2m on two pipeline diversions in GD1 to avoid the risk of damage from flooding and fluvial erosion. The single pipeline diversion scheme proposed for GD2 (Dunkeld R02) is estimated at £25.77m. It is estimated that the materiality of this uncertainty may be estimated to be in the range of possible costs of zero to £15m. the majority of such costs would apply in Scotland with few issues anticipated in Southern.

We recommend a reopener mechanism available during two windows – at the mid-point and the end of GD2, where projects with an expected gross expenditure of greater than £0.5m are considered for funding. Projects will be justified by an EJP and a CBA, both structured in accordance with the existing guidelines.

## 6.8.2 Use-it-or-lose-it mechanism

## Uncertainty mechanism: process safety

During GD1 we have significantly enhanced our procedures to identify both reliability and condition-based defects in our Transmission assets. Projects are now explicitly derived from an objective review of operational defects and results from the comprehensive survey of asset condition in accordance with the CM/4 procedure. For that reason, the Business Plan for Transmission Integrity in GD2 comprises mainly named projects. However, there is still the realistic if unforeseen possibility that new defects impacting asset reliability or condition may be exposed either prior to the start of GD2 or in the early years of the price control period.

In GD1, we have had a particular issue with high pressure filters. These assets receive a detailed inspection involving paint removal and non-destructive testing every 12 years. Occasionally cracks are found, which can be of serious concern if they are present in locations where stresses are elevated. Cast bodied filters are especially at risk. Such defects are sentenced by an independent competent body appointed under the Pressure Systems Safety Regulations and, where necessary, filters have had to be replaced due to the risk of failure at a typical cost of around £25,000. We have recorded 16 such defects in six years within GD1.

In most cases, these filters have been in service for many years and are not covered by manufacturers' warranties. Nevertheless, manufacturers are contacted for advice and support whenever possible.



Also, in GD1, we have had numerous problems within condensing boiler systems, particularly with the aluminium heat exchangers within the boiler itself. These faults lead quickly to complete boiler failure and urgent intervention. Issues have been detected on 24 sites within GD1 with resolution costing, on average between £500,000 and £750,000, to replace the package boiler system.

Other issues include the rapid deterioration of pressure reduction systems with 24 such instances in Scotland linked to aging control systems. In such cases, resolution can cost, on average, around £500,000.

On occasion, we have also been forced to react to third-party incursions. Such incursions include poorly managed quarries, new developments where the pipeline easement contains a 'lift and shift' clause at the company's expense or an increase in risk from nearby structures, such as wind turbines.

Overall, we have been forced to direct around £30m on investment in six years, an average of £5m per annum.

We are confident that the current level of maintenance is sufficient to maintain the safety of the transmission system and to identify these emerging defects promptly and efficiently.

There is no certainty in the volume or type of defects that may be found. Therefore, we propose a 'use-it-orlose-it' allowance where necessary efficient costs incurred to resolve a critical defect are allowed, but any unused allowance is not retained by the company.

The uncertainty in the forecast of unforeseen defects makes it difficult to correctly estimate the required allowances; excessive allowances would benefit the company, while insufficient allowances would put the company at risk. Since health-related defects are driven primarily by duty, age and environment, it is appropriate to claim only the costs of actual interventions.

Estimating costs for GD2 is obviously difficult as the workload is, as yet, unknown. The defects identified in GD1 are understood and any ongoing workload in GD2 already forms part of the GD2 Business Plan. It is also the case that our enhanced inspection procedures are improving our ability to prioritise sites and forecast workloads. It is therefore unlikely that a sum as high as that incurred in GD1, namely £25m over five years, would be required for unforeseen work in GD2. However, a sum of £15m allocated equally between Southern and Scotland networks is reasonable to cover the risk of urgent unforeseen work. In order to ensure the gas customers are not adversely impacted, it is suggested that this be treated as a 'use-it-or-lose-it' allowance of £7.5m per network, £15m overall.

The frequency and probability are unknown. The remediation of known health related defects has been budgeted within the business plan. This uncertainty mechanism is merely to take account of future health related defects.

A 'use-it-or-lose-it' allowance would ensure customers are not disadvantaged through the allocation of excessive allowances.

We propose that the allowance of £7.39m for both Southern and Scotland Networks be awarded at the commencement of GD2 with expenditure assessed during close-out of GD2 and supported by both EJP and a CBA, both structured in accordance with the existing guidelines.

## 6.9 Competition

Refurbishment, replacement and diversion works identified within this paper are fully competitive with materials and labour procurement subject to fully competitive tender either on an individual project basis or for period contracts.

Compliance activities are generally outsourced with period contracts agreed for packages of work, such as inline inspection of high-pressure pipelines. Some select activities, such as CM/4 revalidations, are undertaken by skilled direct labour.



## 6.10 Real price effects

No specific real price effects have been incorporated within this proposal other than those already identified.

## 6.11 Financial summary

The table below demonstrates the expenditure for compliance and integrity work on the Transmission network through GD1 thus far as well as the investment for the remainder of GD1 and throughout GD2. These costs do not include any investment relating to SIU assets, while the costs for GD2 do not include costs for Capacity investment, since this has been separated into a separate appendix in this Business Plan. Details of Capacity related investment and investment in SIU and electrical and instrumentation assets can be found in the Electrical and Instrumentation appendix (026), the Capacity Management appendix (18) and the SIU appendix (017).The investment proposals below are contained within the LTS, Storage and Entry tab, 3.01 of the BPDT.



## Table 29: Financial Summary

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
Compliance									8.3	8.8	7.8	9.3	9.6
LTS pipelines	8.2	11.4	1.8	14.3	15.0	19.9	4.3	2.9	1.5	7.8	9.9	11.2	0.6
Offtakes	1.4	0.3	0.8	1.2	2.2	5.8	13.9	10.9	2.3	4.5	9.2	7.3	0.7
PRSs	3.9	13.6	23.9	36.6	27.4	29.9	18.7	11.3	9.7	17.5	27.2	20.0	13.5
Storage	7.4	1.0	1.6	0.6	0.2	-	-	2.2	-	-	-	-	-
Embedded	_	0.5	-0.2	_	_	0.1	_			_	_	_	_
Entry		0.5	-0.2			0.1		_	_				
Total	20.8	26.9	27.9	52.7	44.7	55.7	36.8	27.3	21.8	38.6	54.0	47.9	24.4
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
Compliance									3.9	3.7	3.7	4.0	4.3
LTS pipelines	6.2	10.2	1.6	10.7	9.4	17.4	4.3	2.3	1.1	5.6	9.9	10.9	0.6
Offtakes	1.4	0.2	0.7	1.1	1.2	3.7	6.2	1.1	1.3	0.5	-	0.1	-
PRSs	1.2	6.9	12.8	14.1	9.0	11.4	5.4	5.8	4.6	8.3	15.6	7.7	7.5
Storage	2.8	0.8	0.1	0.1	0.1	-	-	2.2	-	-	-	-	-
Embedded	_	_	-0.2	-0.1	-0.2	0.1	_	_		_	_	_	_
Entry			-0.2	-0.1	-0.2	0.1		_	_				
Total	11.7	18.0	15.0	25.9	19.5	32.6	<b>16.0</b>	11.4	11.1	18.1	29.2	22.7	12.4
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
Compliance									4.4	5.0	4.1	5.2	5.2
LTS pipelines	2.0	1.2	0.2	3.5	5.6	2.5	-	0.6	0.4	2.3	-	0.3	-
Offtakes	0.0	0.1	0.1	0.1	0.9	2.1	7.6	9.7	0.9	4.1	9.2	7.3	0.7
PRSs	2.6	6.7	11.1	22.5	18.4	18.5	13.2	5.5	5.1	9.2	11.5	12.3	6.1
Storage	4.6	0.2	1.5	0.5	0.1	-	-		-	-	-	-	-
Embedded	_	0.5	_	0.1	0.2	_	_		_	_	_	_	_
Entry		0.5		0.1	0.2								
Total	9.2	8.8	12.9	26.8	25.2	23.1	20.9	15.8	10.8	20.5	24.8	25.2	12.0



In Southern Network, the average expenditure during GD1 will be around £17.7m per annum, while the investment proposed over the life of GD2 averages at £18.66m per annum. Growth related projects were coded to Transmission in GD1 but are accounted for separately in this plan for GD2. The equivalent average investment in GD2 including growth is £20.42m, which equates to an additional £2.7m per annum. Nearly half of all investment in GD2 is targeted at PRS and a quarter is targeted at offtakes. It is a small increase in investment in offtakes and PRS that accounts for the slight increase in average investment. This is exclusively due to the identified condition and poor reliability of these assets that saw little investment prior to the start of GD1.

In the Scotland Network, the average expenditure during GD1 will be around £18.8m per annum, while the investment proposed over the life of GD2 averages at £14.74m per annum. Growth related projects were coded to Transmission in GD1 but are accounted for separately in this plan for GD2. The equivalent average investment in GD2 including Growth is £17.70m, which is a marginal reduction on GD1.

## 6.12 Assurance

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

Our Network Director was appointed as the Sponsor for the Transmission Integrity appendix and the associated CBAs, EJPs and BPDTs, 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 regular self-check or peer review.

#### Second line

This was undertaken independently within the organisation to review and feedback on product development, including GD2 workshops 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 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	BPDT review: LTS, Storage and Entry, and LTS and Entry Assets



# 7 Glossary

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



# 8 Project Annex

Mappowder Offtake
Winkfield Offtake system 2 – South LDZ
Winkfield Offtake System 1 – South East LDZ
Aylesham PRS
Battle System 1 PRS
Battle PRS System 2
Boxhill PRS
Braishfield Offtake C system
Godstone PRS
Hillside PRS
Hurst Green PRS
Reading PRS System A
Shalford PRS
Shatterling PRS
Smarden PRS
St. Mary Cray 1 – Boiler
St. Mary Cray 1 – CHP
Westerham PRS System 1
Westerham PRS System 2
Woking PRS
Hooley Pipe Bridge
Lockerbie Offtake
Provan
St Andrews PRS
Newton Mearns and Waterfoot PRS
Fairmilehead PRS
Airth STRS
Lauder STRS
Georgetown PRS
Aberdeen Craibstone
Carleith PRS
Granton PRS
RO2 Dunkeld
Southern Compliance Projects



Scotland Compliance Projects .....

**Annex Redacted** 

