Initial Proposals of LDZ Shrinkage Quantity
North East and Northern LDZ
Formula Year 2017/18

Northern Gas Networks
1st January 2017
Shrinkage & Leakage Quantities from Initial Model Formula Yr. 2017-2018 SLM v1.4

INITIAL PROPOSAL SHRINKAGE QUANTITY 2017-2018

LDZ Shrinkage Quantity Initial Proposal for Formula Year 2017/18

1. Purpose of Proposal

The purpose of this paper is to present NGN's proposals in respect of LDZ Shrinkage Quantities for the North East and Northern LDZ for the Formula Year 2017/18 as required under Section N of the Network Code.

In Section N of Network Code, Northern Gas Networks has an obligation to submit an estimated LDZ Shrinkage Quantity for each LDZ to provide for the gas that is used by Northern Gas Networks LDZs or lost from its LDZ systems.

2. Summary of Proposal

The LDZ Shrinkage Quantity, set out within the table below, reflect the losses associated with leakage, theft of gas and gas used in the operation of the system. Details of how these Quantities have been determined are provided later in this paper. This report has been prepared in accordance with the UNC arrangements implemented from December 29th 2008 as a consequence of Mod 0225.

The document details Shrinkage Quantities and not Shrinkage Factors.

Fugitive emissions of gas have been calculated on an LDZ basis using a forecasted mains population as at 31st March 2018 omitting NG Metering sites. NGN have used a figure for OUG supported by a review carried out by DNV-GL (formerly Advantica). NGN has considered Theft of Gas and propose using the same factor as last year. The calculations that were used to derive the Shrinkage Quantities and a summary of the underlying information are set out in this proposal.
The Shrinkage Quantity does not include pressure or temperature correction, in line with the agreed methodology.
These Quantities are those proposed for the formula year commencing 1st April 2017

Proposed LDZ Shrinkage Quantity values for the 2017/18 Formula Year

	Existing Shrinkage Quantities 2016/17 Formula Year (Gwh)				**Proposed Shrinkage Quantities 2017/18 Formula Year (Gwh)**			
LDZ	Leakage	OUG	TOG	Total	Leakage	OUG	TOG	Total
North East	187.23	4.25	7.52	198.99	183.96	4.22	7.47	195.65
North	155.10	3.64	6.44	165.18	144.98	3.61	6.40	154.99

The calculations that were used to derive the Shrinkage Quantity values and summary of the underlying information are set out in this proposal.

LDZ	Proposed Shrinkage Quantity (GWh) 2017/18	Proposed Daily Shrinkage Quantity (Kwh) 2017/18
North East	195.65	536,036
Northern	154.99	424,620
Total	350.64	960,656

3. Component Analysis

This section of the document presents an analysis of the components of LDZ shrinkage that make up the estimates for the formula year 2017/18 proposal.

3.1 Leakage

Leakage represents the largest component of the LDZ Shrinkage Quantity.

For the purpose of analysis leakage may be conveniently split into the following three categories:

- Distribution Mains (including service pipes);
- Above Ground Installations (AGIs); and
- Other Losses.

Distribution mains and services leakage is a feature of normal system operation.

AGI leakage includes the routine venting of control equipment. (Routine equipment venting at AGI installations could be said to be Own Use Gas, however for the purpose of this proposal it is included in the AGI leakage category.)

Other losses include gas lost as a result of interference damage and broken mains. These losses are not continuous; they are caused by specific events.

3.1.1 Distribution Mains (and Services) Leakage

The leakage of gas from the Distribution Mains system (which includes service pipe leakage) is calculated by combining the results of the 2002/03 National Leakage Testing programme with the following network[1] specific information:

- forecasted mains population up to 31st March 2018
- the annual average system pressure in each network;
- The measured concentration of Mono ethylene Glycol (MEG) joint treatment chemical in the gas.

Leakage is calculated by multiplying the annual average mains pressure in each network by the Main and Service Pipe Leakage Factors determined by the 2002/03 National Leakage Test programme and the relative lengths of mains / numbers of services in

[1] Network in this context relates to physical interconnected pipe systems.

each network. Where applicable (i.e. cast iron mains only) the Pipe Leakage factors are adjusted to take into account the measured concentration of MEG.

Information relating to the National Leakage Test programme, the application of the results to calculate leakage and the external validation of the results has already been shared with Users and Ofgem; consequently it is not proposed to include additional details in this paper.

The table below shows the Low Pressure leakage on an LDZ basis.

LDZ	Proposed Low Pressure Leakage	
	Tonnes[2]	GWh
North East	8,725	132.96
Northern	7,118	108.45
Total	15,844*	241.40*

The table below shows the Medium Pressure leakage on an LDZ basis.

LDZ	Proposed Medium Pressure Leakage	
	Tonnes	GWh
North East	1,082	16.49
Northern	623	9.49
Total	1,705	25.98

3.1.1.1 Leakage model modification

In February 2012, National Grid proposed a modification to the leakage model to better reflect the impact of low pressure service replacement. The original leakage model contained service population assumptions dating back to the early 1990s and there was no mechanism built in for updating these assumptions to reflect actual service replacement. In 2008, the leakage model was updated to enable the impact of replacement of metallic services to be included; however, this modification did not correct for historic service replacement and did not capture the impact of service leakage reduction associated with transferring plastic services from the old metallic main to the new plastic main. The leakage model modification proposed in February 2012 sought to address both of these issues. The outcome of the consultation was that, the proposed modification would provide a more accurate assessment of service leakage, this modification was approved by Ofgem on 16th September 2014 to apply from reporting year 2014-2015.

[2] The tonnes figure is provided for information (it has no purpose in respect of calculating the Shrinkage Quantity). The conversion to tonnes is based on a Gas Density of 0.73

*Because of rounding differences in the SLM it may result in immaterial changes to overall values

3.1.2 AGI Leakage

The figures for leakage from Above Ground Installations have been taken from the findings of the Transco 2003 Above Ground Installation Leakage Test programme.

Information relating to the programme has already been shared with Users and Ofgem; consequently, it is not proposed to include significant detail in this paper.

The table below shows AGI leakage and routine venting associated with these sites on an LDZ basis.

LDZ	Proposed AGI Emissions[3]	
	Tonnes	GWh
North East	2,219	33.81
Northern	1,745	26.58
Total	3,964	60.39

3.1.3 Other Losses

Gas may be lost from LDZ equipment as a result of specific events, namely broken mains and interference damage to plant, these losses are known collectively as other losses.

Statistics in respect of the number of broken mains and damages are used in conjunction with calculations of the amount of gas lost through each type of incident to derive the total amount of gas lost as a result of these events.

The table below shows the amount of gas lost as a result of 'Other Losses' by LDZ.

LDZ	Proposed Other Losses	
	Tonnes	GWh
North East	46	0.71
Northern	30	0.46
Total	76	1.16

3.1.4 Total Leakage

The table below shows the total amount of leakage for formula year 2017/18 expressed in tonnes and GWh.

LDZ	Proposed Total Leakage	
	Tonnes	GWh
North East	12,073	183.96
Northern	9,516	144.98
Total	21,589	328.94

[3] Includes leakage and routine equipment venting

3.2 Own Use Gas

Natural gas is a compressible fluid; as a direct result of this property, it experiences a drop in temperature when it undergoes an isenthalpic expansion. This means that when gas has its pressure reduced (at an NTS offtake or Local Transmission System regulator site) the gas on the downstream side of the pressure reduction apparatus is colder than the gas on the upstream side.

To avoid the gas leaving a site at below the freezing point of water pre-heating may be applied. (Pre-heating is only needed to maintain gas above 0 degree C and if the gas enters the site at a sufficiently high temperature – e.g. during the summer, or the pressure reduction is small then pre-heating may not be required.)

Pre-heating requires a small proportion of the gas passing through the site to fuel the pre-heating equipment[4].

The model used to assess the Own Use Gas component applies thermodynamic principles with a range of conservative assumptions. These include the supposition that all gas into an LDZ passes through one offtake, and is subject to a two stage pressure reduction process with a plant efficiency assumed to be 50%.

NGN believes that the assumptions used in the calculations, particularly concerning the plant efficiency of the equipment, are pessimistic. That is to say that the calculations overstate the amount of own use gas that is consumed.

NGN recognises that any method to estimate OUG will have limitations but it is a clear Code obligation on all Transporters to use the best information available to estimate OUG in the LDZ.

DNV-GL is well respected within the gas industry with many years' experience in scientific and engineering development. A report published in 2002 proposed OUG figures of 0.0113% of throughput nationally and this represents the overall level of gas used by the GDN for purposes of pre heating at pressure reduction installations.

NGN propose the OUG factor for 2017/18 remains unchanged at 0.0113% which equates to the following Leakage figures:

LDZ	Proposed Own Use Gas Quantity (GWh) 2017/18
North East	4.22
Northern	3.61
Total	7.83

[4] A minority of the smaller pre-heaters use electricity instead of gas as the fuel.

3.3 Theft of Gas

Network Code Section N1.3.2 states that; LDZ unaccounted for gas shall include, and Northern Gas Networks is therefore responsible for, gas illegally taken upstream of the customer control valve and downstream where there is no shipper contract with the end-user.

The available statistics imply that transporters are responsible for between 1% and 4% of theft. However NGN recognising the limitations of the current methodology and the concerns of shippers considers that the proportion of theft attributed to the Transporter should remain at 6.67%, resulting in a theft of gas factor of 0.02% of throughput in line with the 2008 figure, this represents the overall level of Transporter Responsible theft as defined in UNC Section N1.3.2 which equates to the following Leakage figures:

LDZ	Proposed Theft Of Gas Quantity (GWh) 2017/18
North East	7.47
Northern	6.40
Total	13.86

Northern Gas Networks is continuing to engage with Ofgem and other industry parties to better understand the impact of Transporter responsible theft. A number of UNC Modifications have been implemented to help reduce unregistered gas which has occurred as a result of unregistered sites, in particular the re-establishment of registration where a meter is found in-site following Isolation and Withdrawal. Additional work carried out in 2014 showed that a reasonable proportion of unregistered sites are in fact data errors, and therefore do not contribute to this issue. These are being resolved and improved internal processes being developed to reduce instances of this going forward. Further work within NGN to improve theft processes is ongoing and to date there is no evidence that the established theft factors should be amended

4 Detailed Analysis

4.1 Leakage

In May 2003, GL Noble Denton (DNV-GL) on behalf of Transco completed an extensive programme of Leakage Tests. These tests were undertaken at the request of Users.

Before commencing the testing programme, Users were invited to help Transco scope the project. Subsequently Users were updated in respect of progress and had the opportunity to witness one of the tests.

Altogether 849 sets of test results were obtained. The full test results were presented to Users on the 10th of June 2003. Users have subsequently received a report, written by GL Noble Denton (DNV-GL), detailing the programme and its findings.

To ensure that the testing programme was effective Stone and Webster's (a firm of consulting engineers) was asked to investigate the planned methodology. They found that both the proposed testing process and the equipment were fit for purpose. A copy of their report has been circulated.

In addition, Dr Shirley Coleman from the Industrial Statistics Research Unit of Newcastle University was invited to comment upon and discuss with Users the proposed sample plan. It was concluded that the proposed sample was likely to produce the results that were required.

To ensure that the tests were conducted properly, Haswells (a firm of consulting engineers) were invited to observe the training given to test teams and to carry out random audits of the tests as they occurred. Altogether, Haswells audited 77 tests finding that high professional standards were maintained throughout the programme. Haswells produced interim and final reports that have been passed to Users. In addition, Users were given the opportunity to question Haswells during a meeting.

All the data produced by the tests was sent to Dr Coleman for independent analysis. She presented her findings to the Users on the 10th of June 2003 when she also provided them with copies of her report.

Further detail relating to the testing programme and the results that it produced may be found in the GL Noble Denton (DNV-GL) report that has been circulated to Ofgem and Users.

In addition to testing distribution mains, we have also tested our above ground LDZ assets.

The AGI testing programme was introduced during the March 2003 Shrinkage Forum. Subsequently Users had the opportunity to question Dr Peter Russell - who led the work - and to visit a test in progress. To ensure the integrity of the testing programme, Nottingham University (Environment Science Department) examined the testing procedure and Dr Coleman commented upon the results prior to their being used in the Final Proposals in respect of the 2003/04 Gas Year.

We believe that the recent test programmes provide a firm basis for assessing the leakage from both the distribution mains and AGIs; consequently, Northern Gas Networks has utilised the information as the basis for these proposals.

The results of the leakage testing programmes have been used in conjunction with our mains and other plant records, which have undergone a rigorous re-assessment this year.

4.2 Own Use Gas

In the past, Transco has presented details of the method whereby Own Use Gas is calculated. NGN support the opinion, expressed at the 2008 proposal meeting, that the OUG methodology overestimates the figure for OUG due to pessimistic assumptions in the current model, particularly with regard to plant efficiency and the supposition that all gas enters the LDZ via one offtake. The report carried out by GL Noble Denton (DNV-GL) for Transco and published in 2002 concluded that the OUG for calendar year 2000 was 0.0113% based on pre-heater efficiency of 50%. NGN, along with other Networks, engaged GL Noble Denton (DNV-GL) in 2006, to carry out work to consider the sensitivities of the original report. Their work concluded that pre-heater efficiencies range between 53% and 69% and NGN therefore proposes to retain 0.0113% as the OUG figure for Formula Year 2017/18.

4.3 Theft of Gas

Historically Transco figures suggested that the proportion of theft for which Transco was responsible for managing was significantly less than 10%, (see table in Section 3.3).

NGN figures for the period June 2006 to May 2007 support the position highlighted in 2008 that transporter responsibility is substantially less than 10%. In the light of these figures and the most recent NGN figures, NGN consider that theft, which is the transporter's responsibility, continues to be close to 4%. However, NGN considers the issue remains unresolved and therefore proposes that the NGN Theft of Gas factor should remain at 0.02% for the Formula Year 2017/18 based on the transporter being responsible for 6.67% of thefts.

5 Extent to which the Proposal would better facilitate the relevant objectives

This proposal provides an accurate estimate of LDZ leakage and a conservative estimate of LDZ theft of gas and own use gas for the Formula Year 2017/18. As a result, the gas usage and loss in transportation within the LDZs will be reflective of actual conditions. This facilitates the achievement of efficient and economic operation of the system, as NGN will be incentivised to identify opportunities to reduce shrinkage in future years.

It will also lead to better targeting of costs to Users through the RbD process and this is consistent with securing effective competition.

6 The implications for Northern Gas Networks of implementing the proposal including:

a) Implications for the operation of the System:
We are not aware of any such implications that would result from implementing this proposal.

b) Development and capital cost and operating cost implications:
The proposed LDZ Shrinkage Quantity (which do not include Pressure and Temperature correction) lead to a fair allocation of operating costs between LDZ systems.

c) Extent to which it is appropriate for Northern Gas Networks to recover the costs, and proposal for the most appropriate way for Northern Gas Networks to recover the costs:

It is appropriate for each LDZ to incur a share of the overall Shrinkage Energy dependent upon the actual shrinkage in that LDZ.

d) Analysis of the consequences (if any) this proposal would have on price regulation

The continued removal of Temperature and Pressure correction greatly facilitates the establishment and operation of Distribution Network specific transportation charging formula (which is an Ofgem objective). For this reason NGN propose to continue the regime that does not include Temperature and Pressure Correction.
In the longer term this proposal offers the prospect of real savings for consumers through the operation of the principle of comparative regulation.

7 The implications of implementing the Proposal for Users

This proposal improves the equability and accuracy of cost targeting across all Users.

8 Analysis of any advantages or disadvantages of implementation of the Proposal

- **Advantages:** Improved allocation of the actual system usage and losses with improved cost targeting and appropriate incentivisation for future shrinkage reduction.
- **Disadvantages:** Northern Gas Networks is not aware of any disadvantages.

9 Summary of the representations (to the extent that the import of those representations are not reflected elsewhere in the proposal)

N/A

10 Programme of works required as a consequence of implementing the Proposal

UK LINK system changes are required to enable NGN to nominate a fixed daily quantity.

11 Proposed implementation timetable (Inc. timetable for any necessary information system changes)

When we publish our final proposals, Users have until the 15th of March 2017 to request that Ofgem issue a Condition 7(4) disapproval of this proposal. (This provision is in the Network Code Section N 3.1.8.)

If no disapproval notice is issued, it is our intention to implement revised LDZ Shrinkage Quantity from 05:00 hrs. on the 1st of April 2017.

12 Recommendation concerning the implementation of the Proposal

We recommend the proposed LDZ Shrinkage Quantity be implemented with effect from 05:00 hrs. on the 1st April 2017.

13 Northern Gas Networks Proposal

This report contains our proposal for the LDZ Shrinkage Quantity for the Formula Year 2017/18.

The report is based on data sourced from the Shrinkage and Leakage Model (SLM) Version 1.4 which was approved by Ofgem in September 2014 (modification to low pressure service calculations)

Because of the number of decimal places within the formula in the Shrinkage & Leakage Model (SLM), the rounding differences may result in immaterial changes to the overall values.