GL Noble Denton

Report Number: 11170	*30th September 2011*

Allocation of Unidentified Gas Statement

Not Restricted	*GL Noble Denton*

Prepared for:

Uniform Network Code Committee

Prepared by:

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Report approval

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Previous issues of this document shall be destroyed or marked SUPERSEDED

Executive Summary

This second draft Allocation of Unidentified Gas Statement (AUGS) is submitted for review and comment by the Gas Transporters and Shippers as part of the process to develop a methodology to calculate and correctly apportion Unidentified Gas (UG).

The document contains details of the methods developed by the Allocation of Unidentified Gas Expert (AUGE) for estimating the overall level of Unidentified Gas and splitting it between market sectors, the data requested to support this analysis, the data received following such requests, and initial estimates of the total energy value of Unidentified Gas which is split by LDZ and source. Note that at this stage of the analysis, a small number of data items remain outstanding, and whilst this remains the case, the final UG figures cannot be calculated. Therefore the figures supplied in this document are interim values only, and will be finalised when all data items have been received.

In addition to the above, this document describes how the AUGE has followed the published guidelines to date, and contains proposed future analyses for further development of the calculation methodology.

For each area of UG under consideration, the AUGE has provided details of the proposed method of estimating the level of Unidentified Gas from this source, and where necessary, the method of splitting this estimate between Larger Supply Point (LSP) and Smaller Supply Point (SSP) markets. The results of these calculations, given the data currently available to the AUGE, are shown in the Unidentified Gas summary table below. The AUGE welcomes comments on these methodologies and the results that have arisen from them.

It should be noted that the latest calculation method is based on a technique of estimating the total level of Unidentified Gas, directly calculating its individual component parts where possible, and calculating the aggregate effect of the remaining causes (i.e. those that it is not possible to estimate directly in a robust manner) by subtraction as the Balancing Factor. The elements of UG included in the Balancing Factor are:

- Theft
- Errors in the Shrinkage Estimate
- Open Bypass Valves
- Meters “Passing Unregistered Gas”
- Unknown Sites
- Additional Common Cause Variation

Based on the above, the AUGE’s estimates of Unidentified Gas from each LDZ and market sector are as shown in the table overleaf and based on data received up to 26th September 2011. Further updates to the estimates of Unidentified Gas will be applied on receipt of outstanding and updated data and will be published in a separate “AUGS table” with the financial estimates following the consultation period in October.

The total value of Unidentified Gas (across all market sectors) is estimated as **6.66 TWh per annum**.

The estimate of Unidentified Gas arising from the LSP sector is calculated as **2.00 TWh per annum**.

The estimate of Unidentified Gas arising from the SSP sector is calculated as **4.66 TWh per annum**.

UNIDENTIFIED GAS SUMMARY (GWh PER ANNUM)

LDZ	SSP	LSP	Total
EA	757.7	198.6	956.3
EM	554.4	139.2	693.6
NE	402.9	87.6	490.6
NO	367.8	92.8	460.6
NT	128.2	140.0	268.2
NW	269.1	543.0	812.1
SC	169.7	188.4	358.1
SE	458.7	151.2	609.9
SO	334.6	154.9	489.5
SW	315.1	111.0	426.1
WM	538.5	117.2	655.8
WN	37.9	5.6	43.5
WS	317.9	74.6	392.5
LC	0.0	0.0	0.0
LO	2.0	0.5	2.5
LS	0.3	0.1	0.4
LT	0.5	0.1	0.6
LW	1.2	0.1	1.3
Total	**4656.5**	**2004.9**	**6661.6**

The AUGE believes that the methodology described in this document is fit for purpose based on the data sources obtained, reviewed and utilised to date.

Contents

1 Introduction

1.1 Background

The UK gas industry can be segmented into two market sectors; Larger Supply Points (LSP) and Smaller Supply Points (SSP). These sectors are defined by the Annual Quantity (AQ) of gas offtaken from the system in a year. Larger Supply Points have an AQ of 73,201kWh and above, Smaller Supply Points have an AQ of up to 73,200kWh. Many processes within the gas industry differ between these two sectors.

The majority of gas consumed in the UK is metered and registered. However, some gas is lost from the system, or not registered, due to theft, leakage from gas pipes, consumption by unregistered supply points and other reasons. Of the gas that is not directly consumed/measured some can be, and is modelled and some is not. The gas that is lost and not recorded is referred to as Unidentified Gas (UG).

There is currently nothing in place to determine the Allocation of Unidentified Gas between the LSP and SSP market sectors; it is currently all allocated to the SSP market sector. Through the approval of Modification 229 implemented in UNC section H 10 – Mechanism for correct apportionment of unidentified gas [7] provided by an Allocation of Unidentified Gas Expert (AUGE), OFGEM has instructed that this must change and a methodology needs to be defined to ensure that Unidentified Gas can be measured and charged equitably to the relevant gas sectors.

Under the current Uniform Network Code (UNC) charges are made to Shippers for the volume of gas transported which include commodity and energy charges. For LSPs the actual value charged is determined by the volume of gas transported as measured by the metering equipment. For SSPs, the commodity charge is derived by calculating the difference between the volumes of gas measured coming in to the network less the volume of gas measured by the LSPs. Each Shipper with an SSP portfolio is charged a proportion of the total SSP market in proportion to their Annual Quantity (AQ) value against the total SSP market AQ.

As a result of this approach, by default all Unidentified Gas “lost” from the system is charged to the SSP market. This issue has been under consideration for some time and it is generally agreed that Unidentified Gas is also lost from the LSPs, and this Unidentified Gas should be included in the gas volume charged to Shippers with LSPs in their portfolio in addition to those with SSPs.

There have been several UNC modification proposals intended to resolve this issue (Mod 194 [3], 194a [4], 228 [5], 228a [5]), none of which have been accepted by the industry. A further modification, Mod 229 [7] provides for the appointment of an expert (the Allocation of Unidentified Gas Expert or AUGE) with responsibilities for determining of the value of Unidentified Gas so that relevant quantities can be allocated to the correct market sectors.

GL Noble Denton has been appointed to the role of AUGE with the aim of developing a methodology to apportion UG fairly across both the LSP and SSP market sectors.

1.2 High Level Objectives

The AUGE's high level objectives are:

- To determine data required from industry bodies to evaluate Unidentified Gas
- To develop a methodology of calculating Unidentified Gas
- To publish the methodology in the AUGS (this document)
- To consult with the industry bodies and respond to questions / issues raised
- To prepare an AUG table containing Unidentified Gas totals and rates

1.3 Scope

This document contains the following:

- High level overview of the methodology and approach to its development
- Summary of data requested, received and used, and associated assumptions
- Detailed description of the methodology for each part of the Unidentified Gas calculation
- Questions raised by the industry bodies during consultations and responses as appropriate (this is provided as a separate document)
- The final AUGS Table will be provided in a separate document (with financial estimates)

1.4 Out of Scope

The AUGS is not concerned with issues with the deeming algorithm or the RbD mechanism.

1.5 Document status

This section provides a status summary of the Unidentified Gas estimate as contained in this version of the AUGS. Estimates are not final at this stage as certain data items are still outstanding, which prevents the final Unidentified Gas figures being produced at this point. The AUGE expects this data to be available prior to submission of the final AUGS table. Table 1 below shows the status of each element of Unidentified Gas:

TABLE 1: UNIDENTIFIED GAS ESTIMATE STATUS

Unidentified Gas Subject	**Data Status**	**Methodology Status**	**AUGS Status**
Unregistered Sites	Complete	Complete	Final figures supplied
Shipperless Sites	Two data sets outstanding	Complete	Interim figures supplied
IGT CSEPs	Complete	Complete	Final figures supplied
Shrinkage Error	N/A	Complete	Interim figures supplied (as part of Balancing Factor)
Shipper Responsible Theft	N/A	Complete	Interim figures supplied (as part of Balancing Factor)
Metering errors (SSP supply point, NDM LSP Supply point, LDZ offtake metering)	Complete	Complete	Final figures supplied

2 Compliance to Generic Terms of Reference

This section describes how GL Noble Denton has adhered to the Generic Terms of Reference described in section 5 of the AUGE Guidelines [1].

The AUGE will create the AUGS by developing appropriate, detailed methodologies and collecting necessary data.

The AUGE has reviewed previous proposed modifications regarding Unidentified Gas to avoid duplication and to gain understanding of the core issues before devising a methodology. Data required to underpin the analysis has been requested and used to develop the methodology. In this draft the AUGE sets out the approach to and details of the methodology, along with a draft set of figures in GWh. Subject to receipt of the latest shipperless/unregistered sites report a finalised set of figures will be calculated.

The decision as to the most appropriate methodologies and data will rest solely with the AUGE taking account of any issues raised during the development and compilation of the AUGS.

The proposed methodology and assessment of what constitutes Unidentified Gas in this draft has been decided solely by the AUGE based on information supplied by all parties. Comments raised by shippers relating to the first draft of the AUGS have been considered and responses issued, as detailed in Section 7 below. All views expressed have been considered, although all final decisions are the AUGE's own.

The AUGE will determine what data is required from Code Parties in order to ensure appropriate data supports the evaluation of Unidentified Gas.

The AUGE has assessed what data is required to support the chosen methodology and has requested information from relevant parties. Organisations asked for data include Xoserve, the Shippers and Independent Gas Transporters. The data received has been used in the analysis as appropriate.

The AUGE will determine what data is available from parties in order to ensure appropriate data supports the evaluation of Unidentified Gas.

The AUGE has determined data available following discussions with Xoserve, as much of the data required for this analysis is held by them. In addition, the AUGE has requested information on additional areas from Shippers and Independent Gas Transporters.

The AUGE will determine what relevant questions should be submitted to Code Parties in order to ensure appropriate methodologies and data are used in the evaluation of unidentified error.

The AUGE has raised additional questions to the Code Parties as shown in Section 5 below.

The AUGE will use the latest data available where appropriate.

The most recent data available has been requested and received in all cases. Xoserve have set up several processes for producing reports containing new data on a regular basis. These will continue to be supplied to the AUGE to ensure that the latest data is used for each analysis.

Where multiple data sources exist, the AUGE will evaluate the data to obtain the most statistically sound solution, will document the alternative options and provide an explanation for its decision.

It was suggested that mod81 data provides a useful source of AQ information. However, it is limited to AQs that have been reviewed and represents an incomplete data set for the purposes of the UG methodology. A full set of data was provided by Xoserve.

Where data is open to interpretation, the AUGE will evaluate the most appropriate methodology and provide an explanation for the use of this methodology.

This guideline has not needed to be applied at this stage.

Where the AUGE considers using data collected or derived through the use of sampling techniques, then the AUGE will consider the most appropriate sampling technique and/or the viability of the sampling technique used.

This guideline has not needed to be applied at this stage.

The AUGE will present the AUGS in draft form (the "Draft AUGS"), to Code Parties seeking views and will review all the issues identified submitted in response.

The AUGE has documented and reviewed all feedback resulting from the first draft of the AUGS, which was issued in May. Section 8 notes these although the detailed questions and AUGE responses are covered in a separate document supplied alongside this AUGS.

The AUGE will consider any query raised by a Code Party with regard to the AUGS or the data derived, and will respond promptly with an explanation on the methodology used.

Responses were issues to all parties who submitted comments on the first draft of the AUGS, and these are noted in Section 8 - a separate document provides the detail of all responses.

The AUGE will consider any relevant query that was raised during the creation of the previous AUGS and was identified as requiring a change to the AUGS, but was not incorporated into the immediately previous AUGS.

The methods for calculating each element of Unidentified Gas have evolved since the first draft of the AUGS, and in some cases these changes are based on comments received from Code Parties. In particular, various parties indicated that they were uneasy with the lack of robust Theft data available, which has driven the change to calculating Theft by subtraction.

Metering errors were also highlighted as a significant contributer to UG and have been revisited.

The AUGE has also reviewed the shrinkage models to see if there is potential for significant shrinkage error bias, although the revised methodology handles this through the 'Balancing Factor'.

The AUGE will provide the Draft and Final AUGS to the Gas Transporters for publication.

This draft is provided to the GTs for publication on 30th September 2011.

The AUGE's final determination shall be binding on Shippers except in the event of fraud, material breach, or where The Committee unanimously considers it is so clearly erroneous for it to be inapplicable.

This guideline has not needed to be applied at this stage.

The AUGE will undertake to ensure that all data that is provided to it by all parties will not be passed on to any other organisation or used for any purpose other than the creation of the methodology and the AUGS.

On receipt of data, the AUGE has stored the data on our secure project storage area with limited access by the consultants working on the project. The AUGE can confirm data used in the analysis will not and has not been passed on to any other organisation.

The AUGE shall ensure that all data provided by Code Parties will be held confidentially, and where any data, as provided or derived from that provided, is published then it shall be in a form where the source of the information cannot be reasonably ascertained.

Data is stored on our secure project storage area and access limited to those working on the project. Any data that contains market share or code party specific information will be and has been made anonymous to ensure the source of the information cannot be ascertained.

3 Summary of Previous Analyses

This section summarises previous analyses and proposals for the Allocation of Unidentified Gas. This is not intended to repeat previous findings but recognise that a lot of work has been carried out previously to solve this problem.

Methodologies to apportion Unidentified Gas to the LSP/SSP markets have been proposed in a number of network code modifications, notably Mods 194, 194A, 228 and 228A. In addition Mods 115 and 115A sought to correctly apportion NDM error.

Mod 194 proposed an RbD Allocation table which would apportion a percentage of Unidentified Gas to the SSP and Non-Daily Metered (NDM) LSP and Daily Metered (DM) LSP sectors.

Mod 194A was based on 194 and proposed assigning a fixed volume of Unidentified Gas to the NDM LSP and DM LSP sectors.

In both cases, neither proposal populated the tables, with the intention that this would be done via future modification amendments.

Mod 228 proposed to populate the RbD Allocation table proposed in Mod 194 with a percentage of Unidentified Gas allocated to each market sector and a methodology to derive these values. Mod 228 also included a paper [41] from CEPA LLP reviewing the proposed methodology.

Mod 228A was based on Mod 228 and proposed fixed values instead of percentages, again with a methodology to derive these values.

None of the above modifications were approved and the rationale for this is documented in OFGEMs decision letter of 26th May 2010 [14].

In 2004 OFGEM carried out a study on theft in the UK Gas and Electricity Industry [18] followed up by a next steps document in April 2005 [8]. This showed quite a lot of variation year on year for alleged and proven theft cases. It was also noted that increases in allegations were partly attributed to increased detection activity by the Shippers. One common theme was lack of information of the levels of unknown theft and estimates on this vary significantly.

The 228/228A modification report [5] considered three options to calculate theft apportionment and proposed the third option,

- Based on AQ proportions
- Corrected Percentage of 'valid' theft energy
- Simple average between allegations and detected theft

However, it also attributed residual RbD error as being theft. The TPA Solutions report on Mod 228/228A [6] concluded that the hypothesis that reconciliation quantities comprise theft as proposed by Mod 228 did not stand up to scrutiny.

There have been several network code modifications considering theft. Mod 274 [10] proposed an independent agent to determine strategies to improve investigation/detection and prevention but was closed on 26th April 2011. Mods 231, 277 and 346 aimed to improve / consider issues with regard to incentives for detection of theft and are currently awaiting OFGEM decisions.

Based on the information and methods proposed to date the AUGE believes that there are issues with the estimation of theft and previous methods proposed do have fundamental issues. These considerations have led to the AUGE's creation of the approach to theft detailed in Sections 4 and 6 below.

4 High Level Overview of Methodology

This section provides a high level overview of the methodology. For each of the areas of UG presented here a more detailed discussion of each and subsequent methodology (as appropriate) is introduced in section 6.

4.1 LDZ Load Components

Daily load (as measured or calculated at the Supply Meter Point) falls into thee relevant categories as far as the reconciliation process is concerned. These are:

Daily Metered (DM) Load

This is by definition metered and known on an ongoing daily basis.

Larger Supply Point Non Daily Metered (LSP NDM) Load

The deemed load is first calculated using the allocation algorithm on a daily basis. It is then corrected when genuine meter reads become available, with reciprocal corrections being made to the Smaller Supply Point load via Reconciliation by Difference (RbD). At present, the effect of RbD is usually to reduce LSP NDM load. This is evidenced by the fact that across the three calendar years from 2008 to 2010, 79% of RbD values were positive, and the average monthly reconciliation quantity (including both positive and negative values) was 44.2 GWh. The reasons for this are described later.

Smaller Supply Point (SSP) Load

This is calculated using the same allocation process used for LSP NDM load on a daily basis. When actual LSP NDM readings become available, this is subject to RbD, the effect of which is usually to increase the SSP load as described above,

The sum of these three load components does not equal the gas intake into the LDZ due to the presence of two further factors, as follows:

Shrinkage

LDZ Shrinkage occurs between the LDZ offtake and the end consumer (but not at the Supply Meter Point - the LDZ shrinkage zone stops immediately before this point). It covers:

- Leakage (from pipelines, services, AGIs and interference damage)
- Own Use Gas
- Transporter-responsible theft

The majority of shrinkage is due to leakage, and the overall LDZ shrinkage quantity is calculated using the standard method defined in the Unified Network Code (UNC).

Unidentified Gas

Unidentified Gas occurs downstream of Shrinkage, i.e. at the Supply Meter Point. It potentially covers:

- Unregistered sites
- Independent Gas Transporter CSEP setup and registration delays
- Corrections to the Shrinkage estimate
- Shipper-responsible theft
- Meter errors – this includes LDZ offtakes, LSP consumer meters and SSP consumer meters
- Inter-LDZ transfers (error in CV)

Unidentified Gas is currently unknown and hence must be estimated.

In addition to the above factors, there may also be a small element of Stock Change, which represents the difference between opening and closing stock on any given gas day. Given that aggregate Unidentified Gas is based on annual rather than daily consumptions, any adjustment due to stock change (which in this case would be the difference in stock between the start of the UG year and the end of the UG year) will be negligible. It has therefore been discounted from calculations.

4.2 Location of Unidentified Gas in the RbD Process

The AUGE believes that the fundamental basis of this analysis lies in developing a detailed and accurate breakdown of where Unidentified Gas lies at each stage of the calculation and reconciliation process. UNC modification proposals 194, 194A, 228 and 228A went some way towards achieving this goal, but each is based on an incomplete understanding of where Unidentified Gas lies and hence none of these proposals provided a satisfactory solution.

It is therefore important to understand where Unidentified Gas is present at each stage of the calculation in order to quantify it accurately. Under the current reconciliation process, Unidentified Gas is fragmented until after RbD is applied. At this stage it is collected into a single quantity, but exists only as an aggregate with SSP load, where the breakdown of the two is unknown. The quantity of Unidentified Gas can therefore be estimated in one of two ways:

- Calculated directly
- Based on an estimated value for SSP load and calculated by difference

The process of calculating Unidentified Gas begins with the allocation algorithms defined in Section H of the Uniform Network Code, “Demand Estimation and Demand Forecasting” [15]. Whilst LDZ input and DM load are recorded and known on a daily basis, LSP NDM and SSP loads are not, and hence are estimated using the allocation algorithms. These algorithms are based on End User Categories (EUCs), with total NDM load split across a number of EUCs defined by load band and consumption pattern.

Initial allocation is carried out separately for each EUC. SSP load falls within a single EUC (XX:EYY01B, where XX is the LDZ code and YY the year). This EUC covers all loads up to 73,200kWh per annum. The remaining NDM load, which together makes up the LSP NDM category, covers EUCs XX:EYY02B to XX:EYY09B. Each of the bands 03 to 08 are further split into four "Winter:Annual Ratio" categories which are each modelled separately, leading to a total of 33 EUCs per LDZ. The allocation algorithms are trained on data from at least 3900 smaller supply points and 15,000 larger supply points across all EUCs, which have been selected and logged for this purpose.

The initial algorithm results therefore estimate actual load only (i.e. with no Unidentified Gas component) as they are trained on actual recorded load values. They will, however, necessarily include model error as a result of AQ inaccuracy and the natural variability of the statistical modelling process. This does not mean a fundamental error in the mathematical method but the statistical error associated with any modelling process. They do, however, represent the best estimate of EUC loads without Unidentified Gas as this point.

The sum of these estimates is then reconciled against the metered total LDZ load that has been adjusted for shrinkage and with known DM load removed. This is achieved by applying a multiplicative factor to the allocation estimates to ensure that they sum to the right total. Given that the total LDZ load includes Unidentified Gas, the final allocation quantities therefore contain the following elements:

- Actual EUC load.
- Model error. This can be either positive or negative, but it is likely to be positive because at any given point in time, the aggregate AQ of a particular EUC (upon which the allocation algorithm is highly dependent) is usually overstated when compared to the actual weather-corrected consumption for the year. This is true for both LSP and SSP market sectors and is a result of the fact that AQs are consistently dropping from one year to the next, as show in Figure 1 below. AQs are necessarily calculated using historic consumptions, and hence reflect the magnitude of the load during this historic period rather than at the present time.
- Unidentified Gas. This is always positive.

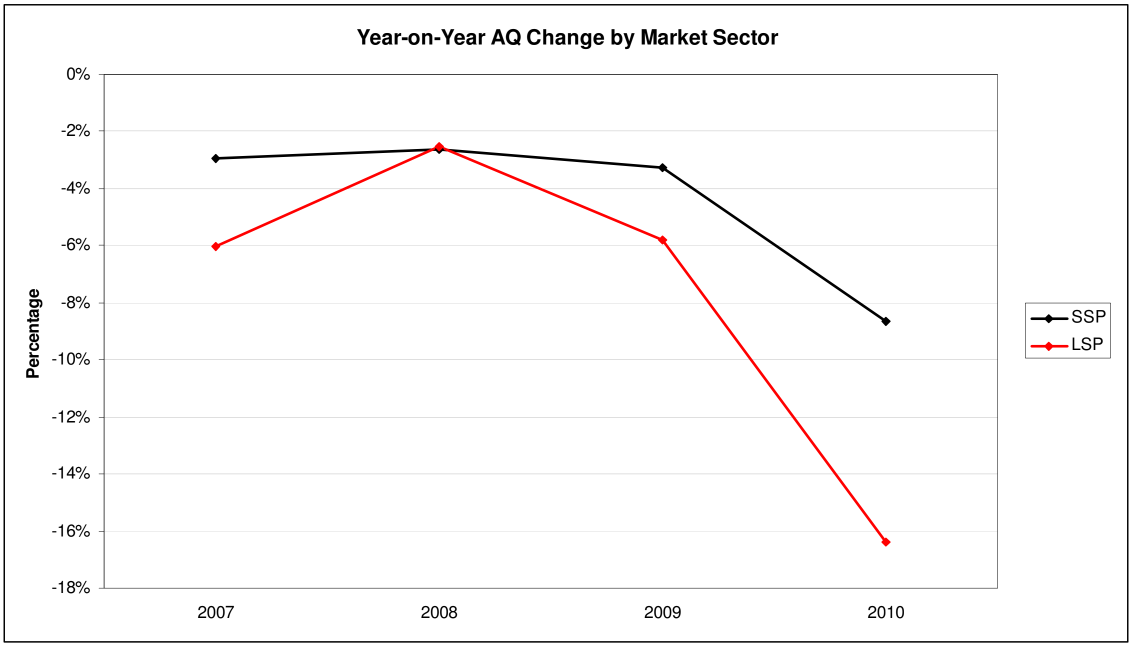

Figure 1 – Aggregate AQ Change by Market Sector

The nature of the calculation means that the Unidentified Gas component is split across EUCs by volume ratio, which is unlikely to represent a realistic breakdown of where it arises. In addition, whilst the components of each EUC load estimate are known (as listed above), the split between them is not.

At this stage, data is aggregated into the standard two categories: SSP load comes from EUC XX:EYY01B, whilst LSP NDM load is the aggregate of the remainder of the EUCs.

The RbD step that occurs after the meter readings for the LSP NDM sector have been made moves all Unidentified Gas to the SSP sector and at the same time eliminates model error since actual loads are now known. In practice, LSP NDM load is usually reduced during this step as discussed in Section 4.1 above, for two reasons:

- Unidentified Gas is removed, which is always positive.
- Whilst the AQ values for all EUCs tend to be over-estimates for the reasons stated above, the level of overestimation is greater for LSP NDM loads than for SSP loads. This is because AQs are, on average, falling more quickly (when expressed as a percentage of the total for the market sector) for LSP loads. This can be seen in Figure 1 above. The allocation calculations therefore have a tendency to skew the load estimate towards the LSP NDM section, and this imbalance is redressed via the RbD calculations.

The RbD process and the movement of Unidentified Gas and model error throughout it are shown in Figure 2:

Figure 2 – Location of Unidentified Gas

It is important to note that the RbD quantity, whilst containing a large element of Unidentified Gas, also contains a significant component of model error. The AUGE believe that the assumption that the RbD value is composed almost entirely of Unidentified Gas (proposed in modifications 228 and 228A) is not valid due to the magnitude of this model error component. The element of RbD that consists of model error should remain in the SSP market sector where it is under the current methodology.

The proposed methodology is based on Unidentified Gas calculations carried out on post-RbD data, with estimates of LSP sector Unidentified Gas being made using the average offset from zero in the quantity of RbD over time. It is at this stage that all the elements of Unidentified Gas are joined together for the first time, as identified in the third stage of Figure 2. The split between actual SSP load and Unidentified Gas is still unknown, however, and so an algorithm is required to estimate this.

This is described in more detail in Section 6.

4.3 Unidentified Gas Methodology

The AUGE proposes to estimate the LSP element of Unidentified Gas only. It is not necessary to calculate the magnitude of SSP sector Unidentified Gas due to the fact that RbD assigns it to the correct market sector already, and hence no action is required regardless of its magnitude. SSP elements of Unidentified Gas are calculated only where it is necessary to calculate the total UG for a particular component part and then split this between the market sectors.

It is known that data for five of the six potential components of Unidentified Gas (unregistered sites, IGT errors, shrinkage error, shipper-responsible theft and metering errors) is available, along with background data on RbD values, AQs, allocation algorithm coefficients, etc. The quality of this data varies from component to component, and the AUGE has therefore attempted to identify the best method of calculating the total level of LSP Unidentified Gas and the split between its causes based on the quality of information available for each component.

The proposed approach is to first assess the extent to which load estimates from the allocation algorithm are skewed towards the LSP sector. This phenomenon has been observed to exist and is caused by the drivers discussed in Section 4.2 above. This natural bias in the models can be compared to the RbD average over time, and the remainder of RbD (i.e. that element not caused by bias) can be attributed to Unidentified Gas. This provides a total figure for LSP sector assigned Unidentified Gas. Elements of this UG total that have good quality data can then be estimated directly, with the remaining elements for which insufficient data exists to produce a robust estimate grouped together and calculated by subtraction. This part of the UG figure is referred to as the Balancing Factor.

Full details of this approach to the analysis, including full descriptions of the calculation methods for RbD bias, model bias and each individual element of LSP UG, are provided in Section 6 of the AUGS. Brief descriptions of each LSP UG element are given below.

a) Unregistered Sites

The AUGE believe these sites should be included in the Unidentified Gas calculations. The data required for this element consists of the historic number and AQ of sites either late registered or unregistered, split by cause and market sector. LSP Unidentified Gas from this source is then calculated by assigning calculated consumption profiles to the validated AQ values from these sites.

b) IGT Connected System Exit Point (CSEP) Setup and Registration Delays

IGT CSEP setup and registration delays should also be included in the Unidentified Gas calculation. Unidentified Gas from this source is due to networks owned by iGTs but not present in Xoserve's records, and also comes from unregistered sites on known CSEPs. The data required for this analysis consists of the number and composition of unknown networks (number of sites and AQ split by market sector), and the number and AQ of unregistered sites on known networks.

c) Shrinkage Error

Shrinkage errors affect the RbD calculation in that initial estimates of shrinkage are used during the allocation process, and the final shrinkage estimates may differ from these. In addition, the Shrinkage Model, which is used to estimate shrinkage values, may return output that differs from actual shrinkage, which is unknown.

The nature of the shrinkage calculation means that these issues only affect the SSP load and the shrinkage account, and they can be either positive or negative. Therefore neither constitutes Unidentified Gas as such (because Unidentified Gas is a physical quantity of gas that has been burnt in an unrecorded manner), but represent a separate issue that affects the RbD process and is, in part, dealt with within that process.

With reference to the difference between initial and final shrinkage estimates, the final shrinkage figures are only known at the end of the gas year, and hence any correction used before this point is based only on an anticipated shrinkage amendment – i.e. an estimate of the error. Whilst the shrinkage error is very small compared to the RbD volume, any estimate of it would necessarily be subject to a large degree of uncertainty. Given that under the current process, as described in Section N of the UNC, the SSP sector and the shrinkage account are reconciled based on final shrinkage quantities calculated after year end, this element is already adequately accounted for and should not be considered part of Unidentified Gas.

Shrinkage Model errors are very hard to quantify, given that actual shrinkage is unknown and that the models are built on the most accurate data available. This is therefore not an area that it is possible to calculate directly, but by default any effects of shrinkage model error are included in the Balancing Factor, and this is therefore where this element is captured.

The AUGE agreed to review the shrinkage models at the UNCC meeting on 5th July 2011 in response to concerns over the validity of the models. This is covered in more detail in Section 6.3.

d) Shipper-Responsible Theft

The AUGE propose that this element should be included in the Unidentified Gas calculation. Very little reliable data on theft exists, however, and whilst information for detected and alleged theft is available, theft by its nature is often undetected. Undetected theft levels are very difficult to quantify accurately, and theft estimates from different sources vary widely, from 0.006% (based on detected theft only) to around 10%. It is therefore very difficult to accurately estimate theft levels directly, and for this reason theft will be calculated by subtraction. It is part of the Balancing Factor, and considered over time, it forms the vast majority of that figure (based on an assumption that the shrinkage models are unbiased, so their contribution can be positive or negative and will sum to a value close to zero over time).

Responses to questions raised by the AUGE regarding theft are summarised in Section 6.6. These provided a useful insight to the initiatives undertaken by the industry to reduce theft and the lengths thieves go to to actually steal gas.

e) Meter Errors

Meter errors can affect RbD and/or Unidentified Gas depending on their source. Errors in LDZ offtake metering and DM supply metering affect RbD, whilst LSP NDM metering errors have the potential to contribute to Unidentified Gas. SSP metering errors have no effect on either figure as they are not used in the calculations. The AUGE have assessed this area and propose that the elements of metering error that actively contribute to Unidentified Gas are included in the analysis.

f) Inter-LDZ Transfers (CV Error)

It has been suggested that unidentified gas could result from inter-LDZ transfers due to errors in the assumed CV. The AUGE will initially assess the potential size of this to determine if further analysis is justified.

The calculation processes detailed above will allow a reliable estimate of Unidentified Gas to be calculated based on the latest available data, which will in turn be used to populate the data table proposed in modification 194/194A. It also gives a sound basis for the year-on-year update of these figures, given appropriate provision of up-to-date information as requested.

4.4 Alternative Method

An alternative method for estimating Unidentified Gas is to calculate a figure for the actual aggregate SSP load (not including UG) based on SSP meter read data, in addition to calculating aggregate actual NDM LSP load in a similar manner. This would allow UG to be calculated by subtraction because under this scenario it becomes the difference between the calculated LDZ load (with DM and shrinkage removed) and the aggregate of the SSP and LSP actuals:

$$UG = LDZ\ Load_{ADJ} - (SSP_{ACT} + LSP_{ACT})$$

The main drawbacks of this approach are concerned with the volume of data required in order to use it and the associated requirement for this data to be of excellent quality. In order to calculate actual SSP load correctly, SSP meter reads (or consumptions calculated from meter reads) would be required for either all sites of this type or for a large sample of them. If all sites are to be used in the analysis, this entails the collection and analysis of a very large amount of data. Using a sample would mitigate this to an extent, although for results to be robust a large sample would still be required, and the process of multiplying up sample results to represent the full population would introduce inaccuracies that would go some way to cancelling out the benefits of this approach.

The potential for missing and/or erroneous information within such a large dataset (whether the full or the sample approach is taken) is high, and due to the volumes of data involved, these would be hard to detect. Data issues of this nature would damage the integrity of the estimates, and could lead to results being less reliable than those from the AUGE's proposed approach. This would lead to a situation where no improvements in accuracy were achieved despite a large increase in complexity.

In addition, this approach only produces an estimate of total Unidentified Gas. As described in Section 4.3 above, it is the LSP element of Unidentified Gas that is important, because SSP Unidentified Gas has already been placed in the correct market sector by the current process. Under this alternative methodology, therefore, processes similar to those described in Section 4.3 will still be required in order to split the total UG estimate between market sectors. This split would be based on the same data as used for the AUGE's proposed method, and would return results of a similar quality. This therefore once again could lead to a situation where no improvement in accuracy has been made despite the increased complexity of the calculations.

Despite these reservations, the AUGE recognises that this method may produce better results than the current proposed algorithms if SSP and NDM LSP load or meter read data can be retrieved reliably for all loads and is of a high quality throughout. In addition, the AUGE has carried out sensitivity analysis of worked UG allocation scenarios, and these have shown that small quantities of LSP UG may be assigned to the SSP market during the allocation process, and the currently available data does not allow these to be estimated. Use of both SSP and LSP actual meter reads may allow an estimate of this quantity to be made. Enquiries have therefore been made with Xoserve concerning the availability and supply of this data, and a response is awaited.

When information from Xoserve has been supplied, it will be assessed by the AUGE and a decision taken as to the best calculation method to use for future years. For the current year, however, given the lack of data and concerns about the impact of any data quality issues, this approach remains the alternative, and it will only be implemented for this year if insoluble issues arise with the proposed methodology.

5 Data Used

This section describes the data requested, received and used to derive the methodology to calculate Unidentified Gas. As a general point it should be noted that during analysis it became apparent that the data available was not always on a comparable basis. The AUGE has therefore taken care to ensure that all datasets include all components of NDM consumption, i.e. CSEPs and Scottish Independents are included throughout.

There have been a variety of issues with obtaining data. This is partly to do with the way the industry currently manages various processes. For example, the AUGE could not obtain a history of data relating to shipperless/unregistered sites over time as only snapshots can be produced. Xoserve now provides regular snapshots so that trends can be identified over time.

There have also been occasions when it is not clear whether a data set includes certain items or not – since some initial issues with the 1st draft AUGS the AUGE has checked with Xoserve in more depth what data sets really contain and equally importantly, what they don't.

5.1 Summary

TABLE 2: DATA STATUS SUMMARY

Data Requested	Status
Ofgem Data Request Items (Updated)	Received
Theft Statistics	Received
Shipperless/Unregistered Sites	Received subject to two outstanding items
IGT Errors	Received
Meter Errors	Received
Questions to Shippers / additional theft information	Received
Questions to iGTs	Two replies received
Additional AQ Data	Received but with outstanding data
Inter-LDZ Transfer Quantities	Requested from networks via Xoserve
PseudoSND Restatements	Received
LSP/SSP meter reads sample	Ongoing

5.2 Ofgem Data Request Information (Updated)

The following data has been requested and received:

- An updated version of the dataset provided by Xoserve to enable the industry to carry out the analyses for Shrinkage, Unregistered/Shipperless Sites, IGT Errors and Theft that fed into UNC modification proposals 194/194A and 228/228A

- Aggregate consumption values for Scottish Independents (excluded from original data).

5.3 Theft

The following additional data concerning theft has been requested and received:

- A list containing records of each occurrence of alleged and confirmed theft, presented with each occurrence as an individual record. For each record, the following details should be included:
  - Date
  - LDZ
  - Shipper
  - Market sector (LSP band/SSP) based on current AQ value
  - Transporter or shipper responsible
  - Estimated volume (kWh) – where the theft allocation has been pursued

Data from 2006 to 2010 has been received.

5.4 Unregistered/Shipperless sites

The following information has been requested and received concerning Unregistered/Shipperless sites. In each case both the number of sites and their aggregate AQ was requested. In addition, all data was split by LDZ, and also between "Small AQ" and "Large AQ" categories.

Xoserve have created a regular report to ensure that new data is collated and sent to the AUGE every two months. This report covers the following categories of Unregistered and Shipperless sites:

- Shipper Activity
  These are new sites created more than 12 months previously, that a Shipper has declared an interest in (such as by creating the MPRN), but are nevertheless not registered to any Shipper. This data is split into sites believed to have a meter and those believed to have no meter.

- Orphaned
  These are new sites created more than 12 months previously, that no Shipper is currently declaring an interest in. This data is split into sites believed to have a meter and those believed to have no meter.

- Shipperless sites PTS (Passed to Shipper)
  These are sites where a meter has been removed and 12 months after removal the network provider visits the site to remove or make the service secure, but find a meter connected to the service and flowing gas. If it is the same meter as allegedly removed 12 months ago it is passed to the shipper concerned to resolve.

- Shipperless sites SSP (Shipper Specific rePort)
  Similar to Shipperless (Passed to Shipper) sites, these are sites where a site visit finds a new meter fitted, in which case it is reported to all Shippers.

- No Activity
  These are sites currently being processed. They will end up in one of the other categories.

- Legitimately Unregistered
  These are sites believed to have no meter and hence are not capable of flowing gas.

- Created <12 months
  These are new sites that have been in existence less than 12 months and are not registered with a Shipper. Action is not taken on such sites until they have been in existence for 12 months.

In addition, the following information was requested:

- A summary of the remaining Shipperless sites, i.e. those that have been Shipperless for less than 12 months and hence do not yet appear in the "Shipperless PTS" or "Shipperless SSP" lists. *This data is still outstanding. When available this data should be added to the above report which will be generated every 2 months.*

- A summary of **all** sites visited to have their service removed due to having been unregistered for more than 12 months, including those where the service was removed as planned. Data should be split between sites where the service was removed and those where gas was flowing and the service was not removed. *This information has been received in summary form, but more detailed background information is outstanding.*

- Opening Meter Reads for orphaned sites to determine the proportion which have been flowing gas prior to becoming registered. This should include the meter read and meter type (SSP or LSP). This data has been received.

- A sample of meter reads for new LSP sites (covering all EUCs 02B and above) to assess whether new sites have a 'ramp-up' profile. This data should include AQ, date meter was fitted, meter read date, meter read value and EUC band. This data has been received.

5.5 IGT CSEP Setup and Registration Delays

At the meeting held on 22nd March 2011, information was presented by Xoserve regarding the number of unrecognised projects (i.e. the number of CSEPs that exist in reality but are not present in Xoserve records). This data indicated that the number of unrecognised projects had dropped from around 3000 to around 1200 between 2009 and 2011. The following data was requested concerning such unrecognised projects:

- Unrecognised projects summary, including
  - number of unknown projects by LDZ
  - count of supply points and aggregate AQ of unknown projects by LDZ

- Composition of all registered CSEPs (AQ and number of sites by market sector).

This data has been received.

5.6 Shipper Specific Questions

In addition to the data requests to Xoserve, the following questions were put to the Shippers:

1. What (if any) initiatives have you implemented to identify theft, and if so, when were they introduced? If these initiatives were only temporary, when did they stop?

   The aim of this question was not to name and shame Shippers but to understand if detection rates are proportionately higher for some Shippers than others, as this will aid the estimation of theft going forward. The requested theft statistics from Xoserve include shipper name so that the AUGE can match theft levels with any initiatives implemented, but reporting will be in non-specific Shipper terms as per AUGE Guidelines.

2. Shippers are required to visit/inspect meters every 2 years. The AUGE requested statistics on the number of customers that have not been visited in the last 2 years by LSP/SSP group. This also required the total number of LSP/SSP customers currently prevailing and therefore any reporting will be in non-specific Shipper terms as per AUGE Guidelines.

3. Additional information on theft over and above data requested by the AUGE from Xoserve that the Shippers believe may be relevant to this subject was also requested.

4. It was suggested by shippers at the industry meeting held on 9th March 2011 that sites may exist, have a meter and take gas without being registered and without an MPRN. The Shippers were asked to provide any further data / evidence that they may have on the likely number of sites and AQ levels involved.

Note that with reference to numbers 1, 2 and 3 above, these questions related to the previous method of calculating theft levels. Theft is calculated as part of the Balancing Factor in the current methodology, and hence the answers to these questions are not currently used in the Unidentified Gas calculations. They are summarised in Section 6 below, however, because they were used by the AUGE as background information and hence influenced development of the proposed methodology.

5.7 Additional AQ Data

In addition to the AQ data included in the Ofgem Data Request (provided in the file 'AQ Totals.xls'), the AUGE has requested the following additional information.

1. AQ data broken down by EUC in order to allow calculations to be performed using the Deeming algorithm. An initial dataset has been provided but issues with this have been identified and an update was requested. This update has been received but too late to be included in this version of the AUGS. The original dataset also excluded CSEPs which are still outstanding
2. Original and revised AQ for threshold crossers i.e. those meters which have moved from SSP to LSP and vice versa. This data has been received
3. Mod81 data. This would provide a more detailed picture of AQ changes through the gas year resulting from the AQ review. Previously outstanding questions over the suitability of this dataset have been answered. In its current form, this data is unsuitable and a request has been made for additional AQ data by EUC post AQ review.

5.8 Outstanding Data Items

Based on information given in Sections 5.2 to 5.7 above, the following data items are therefore still outstanding:

- A summary of the remaining Shipperless sites, i.e. those that have been Shipperless for less than 12 months and hence do not yet appear in the "Shipperless PTS" or "Shipperless SSP" lists.
- A summary of all sites visited to have their service removed due to having been unregistered for more than 12 months, including those where the service was removed as planned.
- AQ values by EUC for CSEPs
- AQ values by EUC post AQ review (requested as Mod81 data was not deemed suitable) including data for CSEPs

In addition, the following information relating to the alternative calculation method is awaited:

- A sample of SSP and LSP meter reads/consumptions to allow data quality and applicability to be assessed.

5.9 Industry Initiatives under Review

The following industry initiatives that may affect the calculation of Unidentified Gas in the future are currently under review:

Mod 369: Re-establishment of Supply Meter Points – Measures to Address Shipperless Sites

This Modification Proposal [2] seeks to modify the existing provisions of the Uniform Network Code regarding Reestablishment of Supply Meter Points to ensure Supply Point Registration where gas is consumed at a Supply Point which has been subject to Effective Supply Point Withdrawal but the original Supply Meter remains connected (or has been reconnected) and is capable of flowing gas. If adopted, this Mod would result in the removal of the "Shipperless Sites (Passed To Shipper)" category from the Unregistered/Shipperless element of the Unidentified Gas calculation. It does not apply to sites where a new meter has been installed and hence the remainder of the calculation would remain the same and as described in this document.

Mod 254: Facilitating the use of forecast data in the UNC

This Modification Proposal [19] has already been implemented and relates to the basis for calculating seasonal normal CWV. It allows for the use of forecast data to account for predicted climate change and could significantly affect the calculation of AQs from 1st October 2010. The effect of this change should be considered further if the AQ based methodology continues to be used.

6 Methodology

This section describes the methodology in detail for each aspect of Unidentified Gas that will be included in the overall Unidentified Gas calculation. The method is based around an assessment of the long-term bias of RbD, which represents the element of Unidentified Gas assigned to the LSP market by the allocation algorithm, along with any allocation algorithm bias. Hence the element of Unidentified Gas assigned to the LSP market is the difference between long-term RbD bias and long-term model bias.

Equation 1:

Avg LSP UG = Avg RbD Bias – Avg Model Bias

Note that in this context, UG *assigned* to the LSP sector is different from UG *arising* from the LSP sector. The nature of the allocation algorithm means that the UG assigned to the LSP sector (which is the quantity being estimated with the analysis) is a mixture of UG that arises from the LSP sector and UG that arises from the SSP sector. Therefore, once the total of UG assigned to the LSP sector has been calculated, it is split into that arising from LSP and that arising from SSP.

The UG arising from SSP is already assigned correctly to the SSP sector by the RbD process, and so the important element is the UG arising from LSP. This is the volume that is currently wrongly assigned to the SSP sector and is hence being paid for by the wrong market sector.

6.1 Long-Term RbD Bias

The estimate of total LSP sector assigned Unidentified Gas is based on the difference between long-term RbD bias and allocation algorithm bias. The monthly RbD quantity behaves in a very variable manner, and is influenced by a number of random and non-random drivers:

- Annual cycle
  The magnitude of RbD varies throughout the year, with larger values tending to occur when larger total demands are present.

- Retrospective corrections
  Where phenomena (such as metering errors) that affect RbD are discovered, adjustments are applied to RbD to ensure that these issues are corrected for and the RbD total is unaffected over time. There is a 4-5 year window during which such corrections can be made, as specified in UNC section E 1.3.9. These corrections cannot be applied to the historic RbD values themselves, however, and so dependent on their type they are either placed in a single current RbD figure or smeared across 6 months or 12 months of current RbD figures. Therefore, values calculated for Month X consist not only of the actual RbD figure for that month, but also the effects of any back-corrections for historic values. Where corrections are large, this can lead to occasional large spikes in RbD values.

- Allocation Algorithm Error
  The allocation algorithm is a statistical estimation process, and as such is subject to random error. Allocation algorithm error consists of a non-zero bias element caused by AQ drift (discussed in detail in Section 6.2 below) along with random variation around this. The purpose of RbD is to redress allocation errors where they occur, and so these errors directly influence the RbD value.

The combined effect of these drivers is to produce monthly RbD figures that vary randomly around a non-zero mean, as shown in Figure 3 below. This shows the distribution of RbD values from 2005 to 2010, which vary around a mean between 800 and 900 GWh per month.

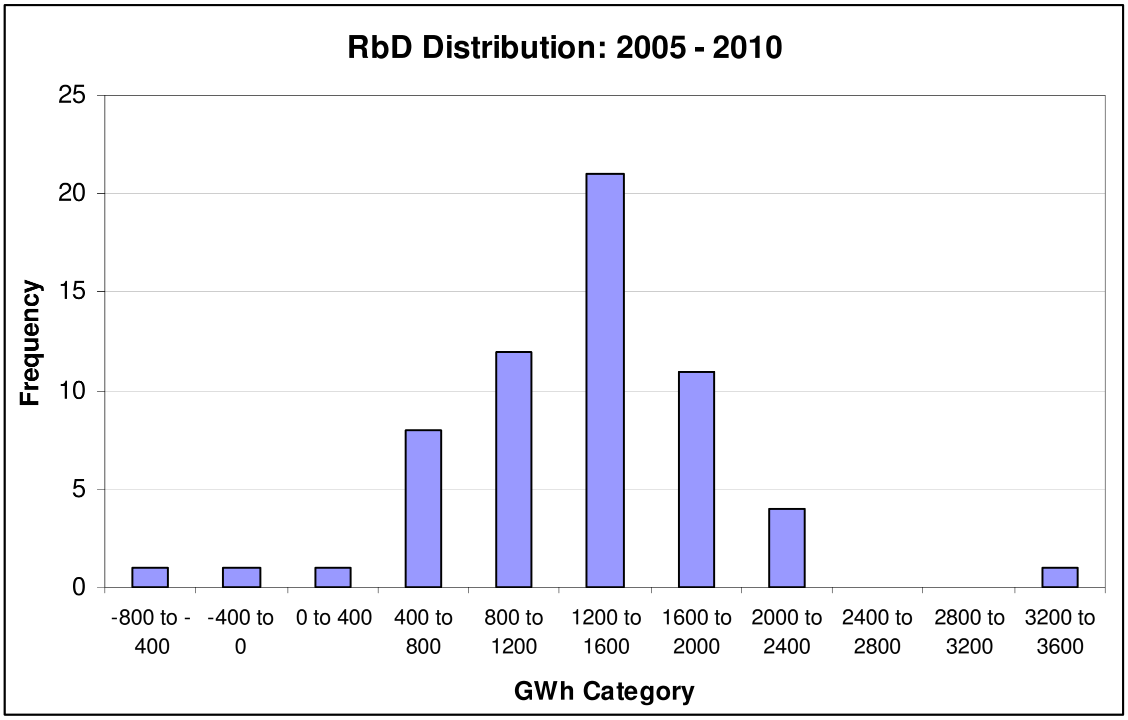

Figure 3: Distribution of monthly RbD values

The use of average RbD bias in the Unidentified Gas calculation is based on the following assumptions:

- Long-term RbD bias is steady over time (notwithstanding the seasonal cycles that occur within this longer-term trend).
- The long-term mean is not affected by the process of applying corrections at a later date.

With reference to the second of these assumptions, it is recognised that individual monthly RbD values will not necessarily represent the RbD situation for the months in question, as they are likely to include back-correction volumes. As long as all necessary corrections are made, however, this does not affect the long term mean. To illustrate this point, consider the case where a series of RbD values should have been:

100, 100, 100, 100, 100, 100, 100, 100, 100, 100

Clearly, the average of this sequence is 100.

If meter errors had occurred, however, and this was back-corrected for later, the sequence could change to:

0, 0, 0, 0, 0, 0, 0, 0, 0, 1000

Even though the individual values are very different, the average remains at 100. This example illustrates why it is valid to use the long-term average of recorded RbD values in order to estimate average RbD offset over time, even though the values themselves are not necessarily representative of the months to which they apply. For the Unidentified Gas analysis it is necessary to use the same time period for the RbD offset calculation as is used in the allocation bias calculation. This is driven by the availability of allocation algorithm data and results in a time period of the formula years 2007-2009 being used.

The average RbD bias calculated over this time period is 9867GWh per year.

6.2 Allocation Algorithm Error

The NDM allocation (deeming) algorithm, as with all models has error associated with it. Some of this error is random but there is potential for the algorithm to introduce a bias into LSP allocations which are then corrected for by the RbD process, as described in Section 4.2 above. These are 'true' reconciliations and do not form part of UG. The AUGE proposes a methodology to quantify this true reconciliation due to the algorithm error.

There are a number of sources of algorithm error as follows

- **Random Error**. This is due to the statistical nature of the model and we assume this is normally distributed with a zero bias.
- **Sample Bias**. The algorithm is based upon a sample of NDM sites. If these sites are not representative of the NDM population as a whole then errors in allocation will result. It is recognised that the sample is not perfect. In particular it does not include any pre-payment meters. Also, as more new buildings are constructed to higher energy efficiency standards (due to more stringent building regulations), the sample population should ideally change to reflect changes in the population as a whole
- **AQ Inaccuracies**. The algorithm is applied by EUC, with each meter falling into one of 33 EUCs. If the meter is classified incorrectly or the behaviour of the meter changes, either in terms of total consumption (AQ) or pattern of use, then the algorithm will not allocate optimally. This category of error also includes the inaccuracy of initial AQs for new meters
- **New Meters/Isolated Meters**. Aggregate AQ will change with the addition/loss of meters. This shouldn't lead to a model bias as the aggregate AQ data used in the deeming algorithm will be calculated using all live meter AQs for the gas day in question. However, there are 2 circumstances under which a bias may result
    - New meters will use an estimated AQ based on no previous consumption history. Errors in this estimate will result in model bias
    - It has been assumed that a meter is removed from the allocation process immediately after it stops taking gas. If a site stops taking gas but is not removed from the allocation process for some time, this will result in the incorrect allocation based on AQ when the true consumption is actually zero
- **Raw Data Errors**. To perform the allocation, the algorithm relies on measurements of LDZ demand, DM demand, estimates of shrinkage and stock change. This data is used to calculate total NDM demand which is then apportioned using the deeming algorithm. These errors are accounted for through RbD when identified.

Of these five sources of error, this part of the analysis is about quantifying the effects of 'AQ Inaccuracies' only. From herein, this will be referred to as 'Model error' and is the result of using inaccurate AQ values which not only drive the overall annual consumption but also dictate the EUC classification. This model error would not be an issue if it was random with a mean of zero. However, AQ values have been consistently reducing year on year. It would be worth noting that some of this model error could be removed by improved accuracy in AQ calculation e.g. as proposed in Mod 209 'Rolling AQ' [21]. AQ accuracy could also be improved if the rate of update of AQs at the annual review could be improved. In 2010, 78% of LSP AQs were recalculated and 87% of SSP AQs (statistics provided by Xoserve). This recalculation rate has shown a slight year on year improvement.

The remaining potential source of algorithm bias which could affect RbD is the sample error which cannot be corrected for without actual meter read data for meters outside of the sample dataset (ideally all meters, but a large sample of additional meters may be sufficient).

In terms of the overall accuracy of the algorithm, this is assessed annually and reported to DESC. The latest such assessment was published in February 2011 [22] and compares the algorithm performance against actual metered data for the sample sites. In these comparisons, the AQ used is based on the actual consumption of the sample meters and therefore excludes errors in AQ. Using this 'actual' AQ along with EWCF and SF=1 (the so called 'best estimate') it is shown that there is no significant bias in the algorithm performance for the sample sites. However, as this analysis is based on the sample sites only, it gives confidence in the values of ALP and DAF which were calculated but does not give any indication of potential bias as a result of using a sample dataset to derive these parameters.

6.2.1 Overview of Proposed Method

The ideal method to estimate model error would be to compare allocations against actual consumption data (from meter reads). This data has been requested from Xoserve but is not readily available. In the absence of actual meter reads, the AUGE proposes a methodology using Annual Quantities (AQs). These can be considered as a proxy for actual consumptions as they are calculated based upon available meter reads as described at the 2011 Xoserve customer discovery event [40].

The proposed method is to compare the results of the deeming algorithm using the data available for the original allocation (hereafter referred to as 'base case') with the results of using the 'best' available data (referred to as 'best case'). Note that we are only interested in the relative proportions of SSP and LSP consumption. The best case algorithm results therefore use a different value of scaling factor (SF), which is calculated to ensure that the total NDM allocation is the same as for the base case (see Figure 4).

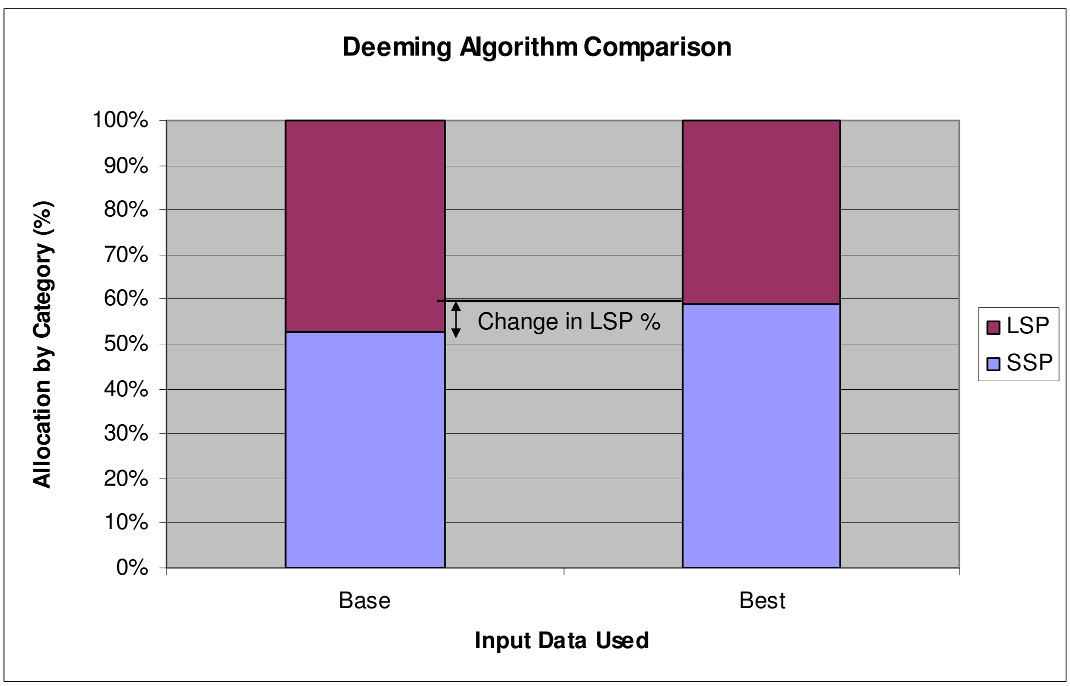

Figure 4 – Example Base vs Best Allocation Algorithm Comparison

This approach is not dissimilar to the Mod228 [5] method which also estimated the change in LSP proportion. One difference is that using the algorithm approach, the proportion is calculated 'bottom-up' by EUC and hence allows for the different profiles (ALPs and DAFs) of each EUC. This should result in a more accurate estimation of the LSP proportion than Mod228 which did not allow for the differences in sensitivity to weather between EUCs i.e. WCF.

It should also be noted that Mod228 attempted to correct for AQ inaccuracies, but failed to address the knock-on effects of AQ changes on algorithm accuracy. Changes in the AQ also affect the Weather

Correction Factor (WCF) as the SND/pseudoSND used in its calculation is based on AQ (see equation 2). This can be seen in Figure 5 which shows the WCF and EWCF (Estimated Weather Correction Factor) for WN, gas year 2007. The EWCF is based on the difference between seasonal normal CWV and actual CWV rather than on the difference between seasonal normal LDZ demand and actual LDZ demand. The two sets of values are very similar through much of the year, but during the last third of the year the WCF reduces significantly resulting in a negative mean (bias). This is caused by the LDZ demand reducing by more than the seasonal normal demand. This was one reason for the introduction of Mod204 implemented in UNC section H 2.5 [20] which allows for the recalculation of the seasonal normal demand quarterly if required. Although UNC section H 2.5 will help to moderate this bias, it only came into effect from gas year 2008 and also only has an impact if the LDZ AQ changes by > 1%. Note also that AQs are rarely updated within the gas year (except threshold crossers). UNC section H 2.5 therefore does not account for the majority of the reductions in consumption i.e. where the AQ is not updated.

Equation 2:

$$WCF = \frac{(D_{LDZ} - SND_{LDZ})}{SND_{LDZ}}$$

Where D_{LDZ} = Metered LDZ Consumption

and SND_{LDZ} = Seasonal Normal LDZ Consumption

Our proposed methodology also accounts for this effect by adjusting the WCF. Further details are provided in Section 6.2.2.

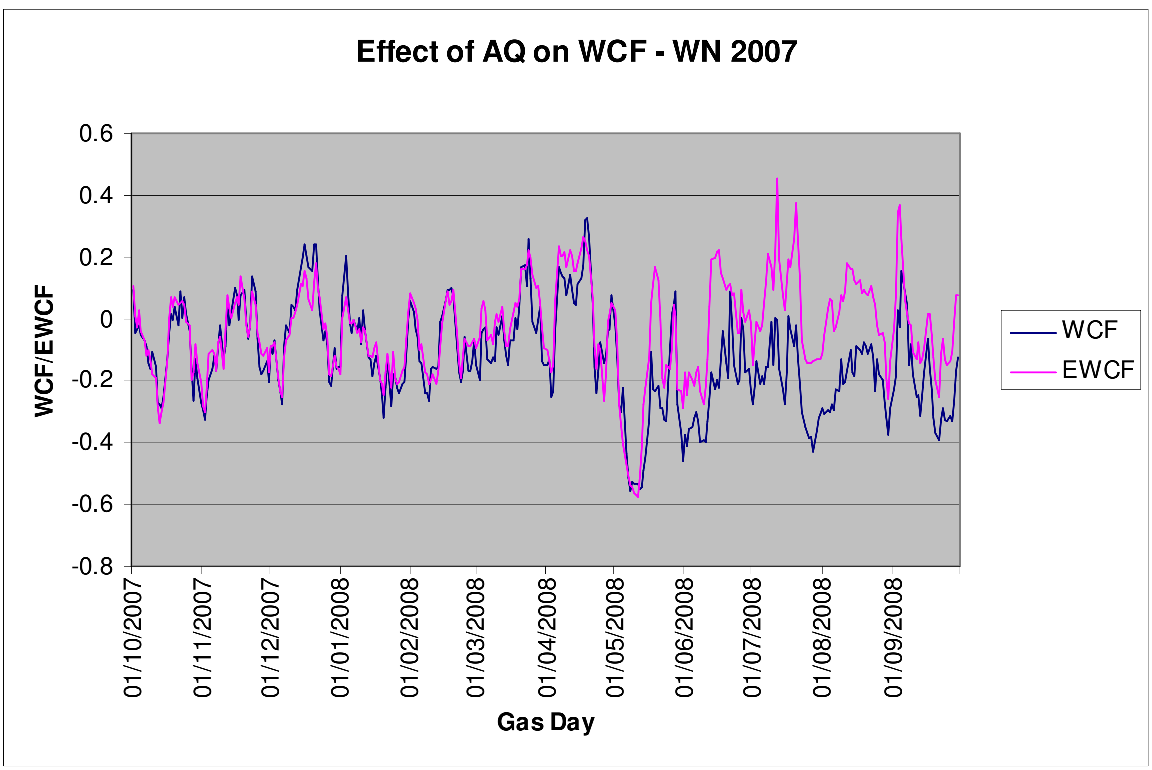

Figure 5: WCF and EWCF, WN LDZ 2007

Note that we have attempted to correct for the data which is derived for use by the algorithm each gas day i.e. AQ and WCF. No attempt has been made to allow for inaccuracies which arise due to the parameter values used (ALP and DAF) which are derived prior to the start of the gas year based on sample data. It would be possible to recalculate these parameters based on the most up to date data and use these optimised parameters in the best case scenario. However, the AUGE believes that inaccuracies due to these parameter values are small compared to other effects (see 'Evaluation of algorithm performance – 2009/10 gas year' [22] which compares the results of the algorithm with current and updated parameter values). An estimate of the additional bias due to errors in ALP and DAF due to sampling is not possible without actual consumption data.

6.2.2 Detailed Algorithm Calculation

The deeming algorithm allows the estimation of LDZ consumption by EUC as given by equation 3. By aggregation, LSP and NDM Total demand can be derived. The process is repeated for each LDZ in turn.

Equation 3:

$$D_t^{euc} = \frac{AQ_t^{euc} * ALP_t^{euc}}{365}\left[1 + DAF_t^{euc} * WCF_t^{LDZ}\right] * SF_t^{LDZ}$$

Where D_t^{euc} = Deemed Consumption on gas day t for end user category euc

AQ_t^{euc} = Aggregate AQ for all meters in end user category euc on gas day t

ALP_t^{euc} = Annual Load Profile for EUC on gas day t

DAF_t^{euc} = Daily Adjustment Factor for EUC on gas day t

WCF_t^{LDZ} = Weather Correction Factor for the LDZ on gas day t

SF_t^{LDZ} = Scaling Factor for the LDZ on gas day t

and $[1+DAF_t^{euc}*WCF_t^{LDZ}]$ is constrained to be >= 0.3

Using original parameter values, the consumption is calculated by EUC (base case). The process is then repeated using updated values of AQ, WCF and SF (best case). If the 'best' value of annual quantity is denoted AQ' then the adjusted version of the weather correction factor WCF' can be found from equation 4.

Equation 4:

$$WCF' = \left[(WCF + 1) * \frac{SND_{LDZ}}{SND'_{LDZ}}\right] - 1$$

Where WCF' = Adjusted ('Best') WCF

WCF = Original WCF

SND_{LDZ} = Original SND at LDZ level. Prior to 2008 gas year, this was the SND estimated before the start of the gas year. For 2008 onwards, this is pseudoSND=$\sum AQ^{euc} * ALP^{euc}/365$

SND'_{LDZ} = 'Best' psuedoSND summed to LDZ level (based on best AQ)

The deeming algorithm is then used to calculate the NDM consumption by EUC with AQ', WCF' and SF = 1. A total NDM consumption is obtained by aggregation and compared to the original total NDM allocation from the deeming algorithm (base case). A new scaling factor is then derived (SF') and applied to the updated allocation results to ensure that the total NDM allocation is the same in both the base case and best case. SF' is defined in equation 5.

Equation 5:

$$SF'_t = \frac{D_t}{D'_t}$$

Where SF'_t = adjusted scaling factor

D_t = total LDZ level NDM allocation based on original parameters

D'_t = total LDZ level NDM allocation based on AQ', WCF' and scaling factor = 1

Finally, the model error can be calculated for SSP and LSP by subtracting the base case allocation from the best case allocation.

6.2.3 Base Case Results Validation

There were two reasons for using the base case rather than just using the original allocations. Firstly, the allocation data was not available at the required level (by gas day) in order to calculate SF'. The second reason was to remove the effect of AQ variation through the year. The AQ data provided by Xoserve is the aggregate AQ for 1st October. No information is available on the day by day variation of AQ. It is the AUGEs understanding that this information is not stored beyond the current gas year (i.e. for previous gas years). It is therefore expected that the base case allocations will differ from the true allocations due to intra-year AQ changes. By calculating both the base case and best case allocations with constant AQ values throughout the gas year, a like for like comparison can be made thus allowing an estimate of error solely due to different AQs.

The base case should give results very similar to the actual allocations. Differences will be the result of any aggregate AQ changes within the gas year. These changes will be made up of new/isolated meters and meters whose AQ has been amended (which we believe are relatively small, see section 6.2.4 below). A comparison was made between the base case and the original allocations to confirm a degree of consistency.

Unfortunately, a direct comparison was made more difficult by the absence of AQ data by EUC for CSEPs (not yet received from Xoserve). As the AQs exclude CSEPs, the base case algorithm results will not include CSEPs, but the allocation data provided by Xoserve does include these. However, AQs for CSEPs were available at an aggregate LDZ level. In order to allow a comparison, the LDZ level CSEP AQs were subtracted from the allocations to estimate the allocation excluding CSEPs. Note that this is an approximation as it ignores any weather effects.

Table 3 below summarises the differences between allocations calculated using the base algorithm and the actual allocations adjusted for CSEPs. The table shows the percentage difference between the base case allocation and the actual allocation (negative values represent an under-estimate by the algorithm compared to the actual allocations).

These results clearly show that there is an issue with WS which is caused either by incorrect AQs or actual allocations. This issue is under investigation by Xoserve. Looking at the difference in the total NDM across all LDZs except WS, it can be seen that the agreement between the base case algorithm and the actual allocations is good (maximum <1% difference).

Looking in more detail, it can be seen that in the case of SSP allocation the base case consistently underestimates by a small amount which is expected due to the increase in number of SSP meter points through the year. The differences in the case of LSP allocations are larger and more variable which is expected due to the higher variability in behaviours between LSP meters.

TABLE 3: COMPARISON OF BASE ALGORITHM AND ACTUAL ALLOCATIONS

LDZ	SSP			LSP		
	2007	2008	2009	2007	2008	2009
EA	-0.7	-0.4	-0.7	-1.9	-1.6	-1.1
EM	-0.1	0.1	-0.3	2.2	2.2	2.2
NE	-0.1	0.1	-0.3	-1.6	-1.0	-3.4
NO	0.1	0.4	-0.1	11.9	13.5	13.4
NT	-0.3	-0.3	-0.5	2.7	0.2	0.9
NW	-0.1	0.1	-0.2	0.2	-1.7	-2.8
SC (excl. Indep)	-0.5	-0.3	-0.4	-2.3	-3.4	-3.9
SE	-0.4	-0.4	-0.5	-1.5	-3.9	-5.2
SO	-0.4	-0.4	-0.5	8.6	8.6	9.6
SW	-0.8	-0.9	-1.1	-3.4	-5.4	-4.9
WM	-0.1	0.1	-0.2	-1.7	-1.5	-1.5
WN	-1.0	-0.8	-0.8	-1.4	-4.7	-5.2
WS	-0.3	-0.3	-0.4	87.2	91.5	97.0
Total	-0.3	-0.2	-0.4	3.7	3.0	2.9
Total Ex WS	-0.3	-0.2	-0.4	0.9	0.0	-0.2

6.2.4 AQ details

AQ is fundamental to the current allocation process and any errors in AQ estimates will contribute to RbD. It is therefore essential to understand the process for calculating and using AQ values in the allocation process.

AQ values are set at the start of the gas year based on the AQ review. Through the gas year, the deeming algorithm uses the aggregate AQ (for each EUC) applicable on a given day. This value will reflect any changes made to individual meter AQ values and any new and isolated meters will be accounted for in the aggregate AQ. If a meter changes EUC within the gas year, this will also be reflected in the aggregate AQ values for the corresponding EUCs.

Within the gas year, any LSP or potential threshold crosser (SSP to LSP or vice versa) can have its AQ amended, but this facility is not often used ("Review of Reconciliation by Difference (RbD) Xoserve response to Consultation Ref: 57/06" [23]). UNC E 7.4 [39] incentivises shippers to amend AQ in a timely manner for meters moving from SSP to the LSP market. The contribution of threshold crossers to changes in AQ is small as they tend to cancel out. Figure 6 shows how the total AQ changes year on year, highlighting the small proportion which is due to threshold crossers. The bulk of the change in AQ is the result of changes in AQ of existing meters which remain within the same market sector and the change in the number of meters making up the aggregate.

Further confirmation of limited AQ changes through year comes from the frequency of pseudoSND updates. PseudoSND is reviewed every 3 months. If the aggregate LDZ AQ has changed by more than 1% then the pseudoSND is recalculated and re-issued. See UNC section H 2.5 [20]. Since its introduction in 2008 an update to pseudoSND has occurred in the third quarter of each gas year. In 2008 and 2009, this affected one LDZ (WN in 2008, SW in 2009) whilst in 2010 five LDZs were restated (NT, SC, SO, SW, WN).

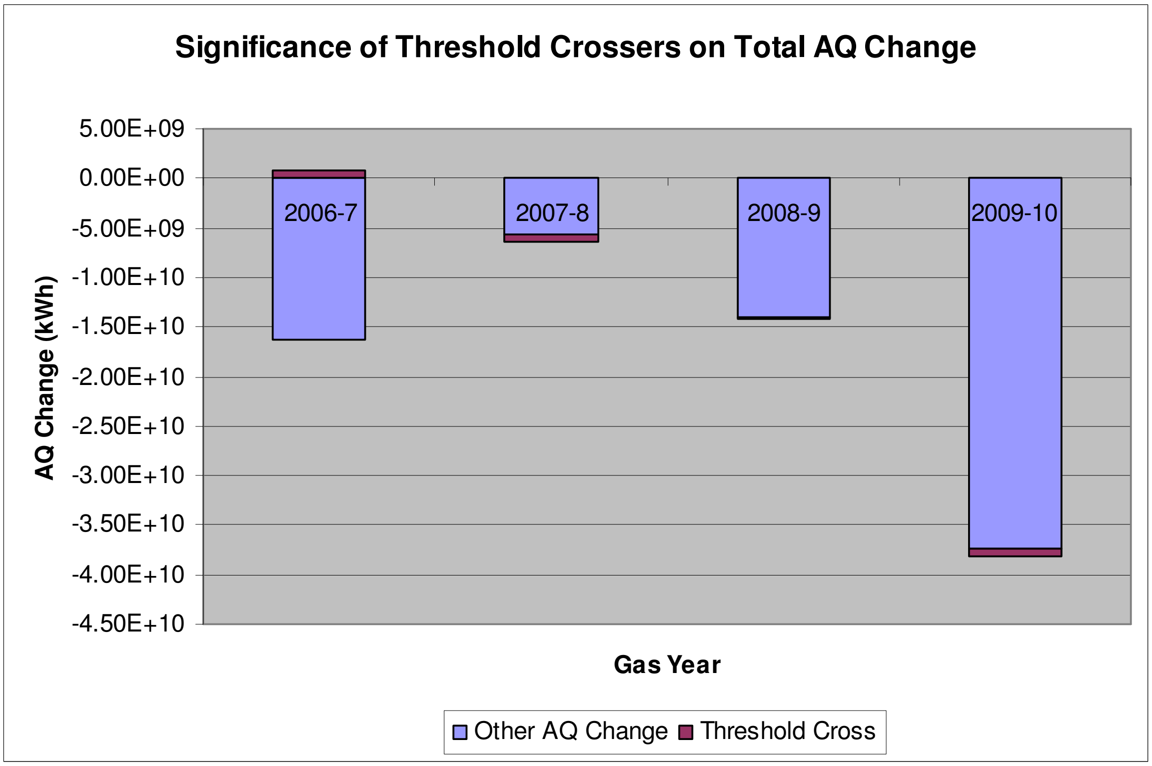

Figure 6: Year on Year AQ Change

Figure 7 is an overview of the timing of the AQ review process for LSP meters. The blue (light grey) bar is split into sections representing gas years. The process for calculating AQs for the 2010 gas year starts in May 2010 with the recalculation of AQs based on the most recent meter reads. The orange (dark grey) bar in Figure 7 shows the period of actual metered consumption data which would be used to calculate the AQs. This is the ideal scenario where a meter read is available close to the point of recalculation and there are meter reads spanning the period up to 1 year earlier. Depending on the availability of meter reads this window of measured consumption will move.

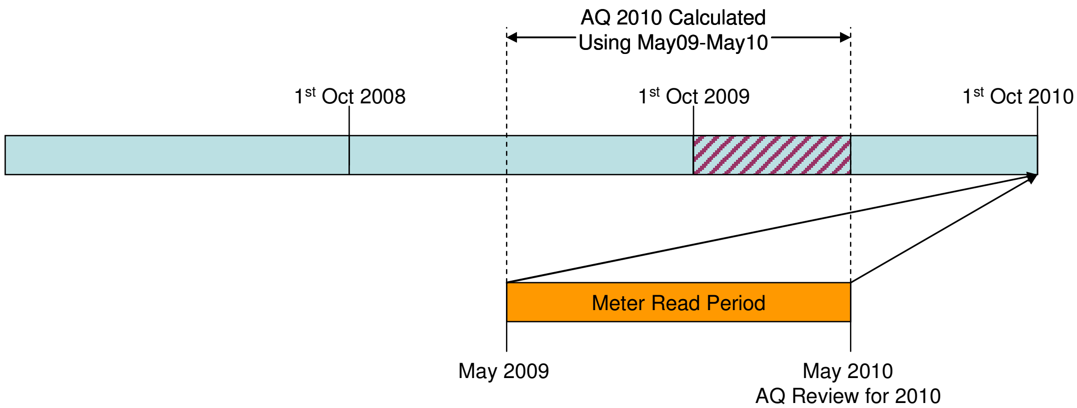

Figure 7: AQ Change Calculation

Now considering the gas year 2009, the original AQs for this gas year will be based upon meter reads over the period May 2008 to May 2009 (ideal case). A better estimate of the AQ for this gas year would therefore be the AQs calculated for use at the start of the following gas year (2010), as these are based on meter reads over the period May 2009 to May 2010. The shaded bar in figure 7 shows the period where the period of meter reads used to estimate the AQ and the gas year overlap. This period of overlap includes the winter where consumption is highest. It is therefore suggested that an improved estimate of AQs for use in the deeming algorithm are the AQs calculated for the following gas year i.e. AQs are offset by a gas year. It is recognised that the availability of meter reads may mean that the period of overlap is reduced but regardless of this, the AQ for the following gas year will remain a more representative value than the original AQ as it will be based on actual consumption data nearer to the period of interest.

The approach of using lagged AQ values described above holds true at the individual meter level and is equally valid for LSP and SSP meters (though the meter read availability will be different). This approach also accounts for meters which have switched from SSP to LSP or vice versa. One issue with using this approach however, is that the aggregate AQ will be different due to the meters in the aggregate i.e. new and isolated meters. Given that the within year AQ change is usually <1% (as evidenced by the small number of pseudoSND restatements), it can be concluded that the change in aggregate AQ due to new and isolated meters is small compared to the change in AQ resulting from the AQ review. Despite this, the AUGE intends to quantify and remove this effect and are awaiting data from Xoserve to enable this. We would expect this to result in a slightly lower model error.

Although the approach described attempts to quantify model error based on inaccuracies of the aggregate AQ by using more appropriate AQ values (post AQ review), not all meters have their AQ updated as part of the review process. Mod 254 [19] states "a significant proportion of all NDM meter point AQs are not revised in the annual review". Data to support this was requested from and showed that for the 3 gas years 2008-2010, approx 76% of LSP meter points AQs were recalculated and approx 85% of SSP meter point AQs. The main reason for failure to calculate the AQ is a lack of valid meter reads. It is not unreasonable to assume that the AQs of the meters which have not been updated in the AQ review have changed in a similar manner to those which have been updated. The AUGE therefore intends to apply a scaling factor to the AQ values to take account of this before producing the final AUGS table. This will have the effect of increasing the model error.

6.3 Shrinkage Error

Shrinkage Error is not strictly a component of Unidentified Gas, and hence no attempt is made to estimate it directly. The reasons for this are described below, where the AUGE's understanding of LDZ shrinkage and how it applies to the RbD process is outlined. LDZ load is made up of the following elements:

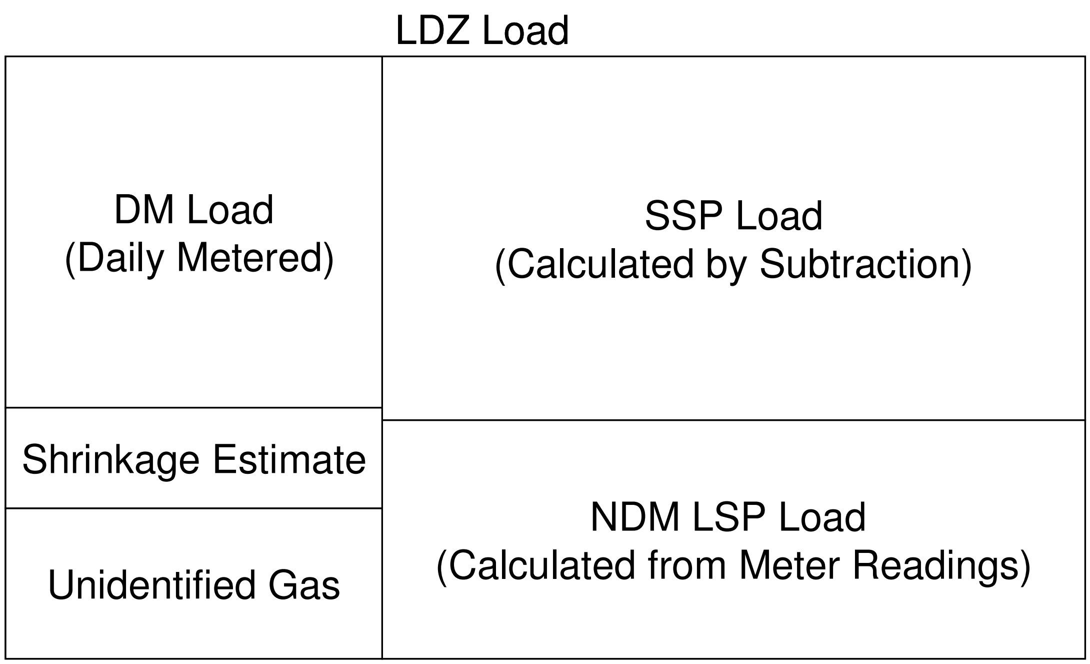

Figure 8 – Composition of LDZ Load

LDZ Shrinkage is comprised of:

- Leakage
- Own Use Gas
- Transporter-Responsible Theft

Each element is calculated as specified in the UNC on an LDZ by LDZ basis. The total Shrinkage value is then the sum of the components (see Figure 8). Calculations are carried out by the Gas Transporters (GTs) who own the LDZ in question (i.e. National Grid Distribution, Northern Gas Networks, Wales and West Utilities and Scotia Gas Networks).

Initial values for any given formula year ahead are calculated and submitted by each GT during the previous December (e.g. Dec 2010 for the formula year 2011/12). Final proposals are submitted during March. All of the elements of LDZ Shrinkage are throughput dependent, and so throughput values for the year ahead are estimated using recent years and/or seasonal normal demands. These final versions of the Shrinkage values go into the NDM demand allocation and RbD calculations.

Each Shrinkage element is estimated as follows:

- Leakage
  Distribution Mains and Service leakage is calculated using the results from the 2002/03 National Leakage Tests [16], along with forecast mains/service populations (based on planned replacement for the year ahead), average system pressure and average Monoethylene Glycol (MEG) levels for the network in question. Above Ground Installation (AGI) leakage figures derive from the findings of the 2003 Above Ground Installation Leakage Tests.
- Own Use Gas
  This element of shrinkage is estimated using the GL Noble Denton Own Use Gas model, which was developed in 2002 [37] and verified through further research in 2006 [17]. This estimates that a national average of 0.0113% of throughput will be used as OUG, based on a pre-heater efficiency figure of 50%. This national average is applied to all networks.
- Transporter-Responsible Theft
  It is recognised that reliable data on the actual level of theft (as opposed to detected theft levels) is sparse. The current consensus is that 0.02% of LDZ throughput is lost to Transporter-Responsible theft, and this is the figure used in all Shrinkage calculations.

The purpose of including the category of “Shrinkage Error” in the Unidentified Gas estimate (as proposed in Mods 194/194A and 228/228A) was to acknowledge the fact that the Shrinkage values supplied in advance of the formula year are only estimates and that the actual shrinkage that takes place during the year will not match the supplied figures. Therefore, some provision for accounting for this difference in the RbD calculation and/or Unidentified Gas calculation was sought.

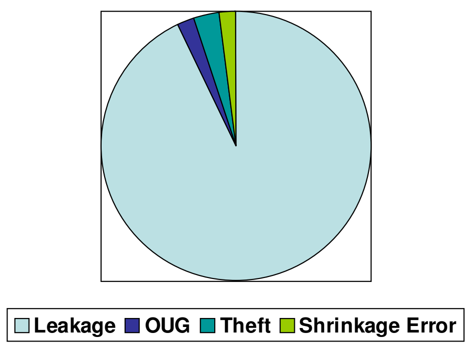

Figure 9 – Composition of Shrinkage

The effects of errors in the shrinkage estimate differ depending on whether the initial estimate is too high or too low:

- If the initial estimate is too low, actual Shrinkage is higher than the published estimate. This is an additional amount of Shrinkage gas which has actually been assigned to the SSP sector via RbD, but should actually have been charged to the Shrinkage Provider. The Shrinkage Provider is usually the GT for the network in question.
- If the initial estimate is too high, actual Shrinkage is lower than the published estimate. This represents the amount of gas which should be assigned to the SSP sector but has actually been charged to the Shrinkage Provider. Therefore this requires a credit to the Shrinkage Provider, with the difference charged to SSP.

It is important to note that these differences are not a part of Unidentified Gas, due to the fact that Unidentified Gas is a (positive) physical quantity of gas that has been burnt somewhere in an unrecorded manner. Corrections to the Shrinkage estimate can be positive or negative, and are in effect changes to the SSP sector and shrinkage account only. This is therefore a correction to RbD rather than Unidentified Gas. The necessary correction to RbD is already carried out as part of the GTs' post-year process.

After the end of any given formula year, the GTs once again calculate an estimate of Shrinkage for each of their LDZs, but with the basis of the calculations changed as follows:

- Actual throughput figures are used rather than estimated ones.
- Actual mains and service populations are used rather than those estimated from planned replacement.

The Shrinkage estimate is adjusted using these corrected values and adjustments made to both Energy Charges and Commodity (Transportation) Charges.

Each GT provides a statement after the end of the year containing the volume and financial adjustments, and it is assumed that these are applied to RbD as recommended in the documents. If this is the case then any Shrinkage errors are thus negated using the most accurate information available. Whilst this only happens some time after the event, it nevertheless ensures that RbD is adjusted for Shrinkage estimate errors.

The existence of this post-year process means that the only reasons for including Shrinkage Error in the Unidentified Gas calculation would be as follows:

1. If there was some reason to believe that the amended Shrinkage estimates were biased:
The models used to create the shrinkage estimate will necessarily contain an error component, but as long as they are unbiased (i.e. as long as the errors are distributed evenly around zero and sum to zero over time) this have no net effect on RbD. If they are believed to be biased, however, then the perceived inaccuracy could be included either in the Unidentified Gas estimate or as a correction to RbD. Each element of Shrinkage is already calculated using the most accurate information available, however, with estimates based on GL Noble Denton models for mains and service leakage, AGI leakage and OUG. Therefore, any corrections would be more likely to increase errors rather than decrease them. Should any opportunities to improve the estimates arise in the future, these would be best incorporated via a change to the current calculations rather than a post-processed error correction.

2. If there was a need for Shrinkage error to be included before the event rather than after the end of the formula year in question:
This approach would bring its own problems, in that any estimate of the Shrinkage error made in advance would be subject to error itself. Hence a correction after the end of the year would still be required – in effect we would just be shifting from a "Correction to the Shrinkage Estimate" to a "Correction to the Corrected Shrinkage Estimate". This is self-defeating and hence should not be implemented.

Based on this analysis, it is therefore concluded that the current Shrinkage estimation system is fit for purpose and provides the most equitable solution available. Section 6.3.1 examines the shrinkage models in more detail.

Regardless of whether shrinkage model errors sum to zero or are biased over time, however, any long-term bias in the shrinkage models, should it exist, is automatically included in the Unidentified Gas calculation via the Balancing Factor. This ensures that even if the shrinkage models are biased, the final calculated SSP sector load will be unbiased over time. Therefore the Unidentified Gas calculation addresses this issue by its nature. It is nevertheless important for the shrinkage models to be as accurate as possible. If they are found to be biased, however, improvements are best made in the shrinkage models themselves rather than in the Unidentified Gas calculation.

6.3.1 Review of Shrinkage Model

During the 1st consultation period a number of issues were raised regarding the handling of Shrinkage, and in particular Shrinkage Error. These were concerned with the potential for bias and erros in the Shringkage estimates giving rise to UG, and a concern that as the AUGE had been involved in projects to devise the Shrinkage models in the first place that there could be potential conflict of interest. These issues were raised by British Gas in response to 1st Draft AUGS [25].

Since the 1st draft AUGS the AUGE has obtained further data from Xoserve, and has modified the Unidentified Gas methodology based on this additional information. The effects of Shrinkage errors are now handled differently via the Balancing Factor, such that any gas from this source is accounted for regardless of whether the Shrinkage models are unbiased over time or not.

Nonetheless, at the UNCC update meeting on July 5th, the AUGE agreed to revisit the Shrinkage models to assess whether potential bias exists.

Each year the GTs estimate Shrinkage volumes for the coming year based on the different Shrinkage model components. Figure 10 below shows a summary and breakdown of the proposed Shrinkage amounts for each LDZ from the four GTs [26], [27], [28], [29].

Shrinkage GWh							
	LP	**MP**	**AGI**	**Other**	**OUG**	**Theft**	**Total***
NE	207.34	17.01	23.83	1.45	4.55	8.05	262.23
NO	154.98	10.5	31.19	1.15	4.05	7.17	209.04
WN	28.2	3.5	22	0.1	0.8	1.5	56.1
WS	19.2	10.1	22.3	0.3	4.7	8.4	65
SW	194.9	21.4	30.9	1	3.5	6.3	258
SC	see MP	206	34	1	6.2	10.9	258.1
SO	see MP	335	30	1	7.5	13.2	386.7
SE	see MP	216	34	1	4.6	8.2	263.8
EA	165	15	40	0	5	9	235
EM	221	43	40	1	7	13	325
NT	277	25	36	1	6	11	356
NW	339	18	48	1	8	14	428
WM	269	23	40	3	5	10	349
Total	**see MP**	**2819.13**	**432.22**	**13**	**66.9**	**120.72**	**3451.97**

* National Grid totals taken from Final Shrinkage proposals, breakdown taken from initial proposals. Breakdown does not necessarily sum to 100% due to rounding.

Figure 10 – Proposed Shrinkage Volumes for 2011/12

Figure 11 shows the relative percentage contribution of each component of Shrinkage to the total by LDZ.

Shrinkage components as a % of total				
	Leakage	**AGI**	**OUG**	**Theft**
NE	85.6	9.6	1.7	3.1
NO	79.2	15.5	1.9	3.4
WN	56.5	39.4	1.4	2.7
WS	45.1	34.8	7.2	12.9
SW	83.8	12.4	1.4	2.4
SC	79.8	13.6	2.4	4.2
SO	86.6	8.0	1.9	3.4
SE	81.9	13.3	1.7	3.1
EA	76.6	17.0	2.1	3.8
EM	81.2	12.6	2.2	4.0
NT	84.8	10.4	1.7	3.1
NW	83.4	11.4	1.9	3.3
WM	83.7	12.3	1.4	2.9
Overall	77.6	16.2	2.2	4.0

Figure 11 – Percentage contribution of each component of Shrinkage

Of these, the greatest contribution is from Leakage (which accounts for over 75% of the shrinkage amount except in WN and WS LDZs), followed by AGI (including other losses), Theft and OUG.

The next sections review each of these components in turn.

6.3.1.1 Leakage

Low and medium pressure leakage is calculated based on the number of different types of service pipes in the network where leakage typically occurs (particularly at metal-metal and metal-plastic joins), and the leakage factors associated with those service pipes.

In 2002/3 GL Noble Denton was commissioned to update the leakage rates used to assess overall distribution system leakage that had previously been derived in 1992. There was an objective that the test programme should establish leakage rates with the total leakage estimate having a 90% confidence interval of ±10% around the mean value.

A series of tests were devised and leakage tests carried out using specially designed equipment to collect the data, improving accuracy and efficiency of the data collection. The sampling approach and results were reviewed by an independent 3rd party, the Industrial Statistical Research Unit [31].

The equipment used to carry out the leakage tests was also independently reviewed by Haswell Consulting Engineers [32] (engaged by National Grid), who carried out a continuous independent physical validation study during the programme.

More tests were carried out than initially required as some mains initially recorded as pit cast iron pipes turned out to be made of other materials. Additional samples were taken to ensure the original sample plan was achieved.

The result for the whole Distribution network system was found to be 0.156 m3/hr/km @ 30mbar, compared to 0.304 m3/hr/km @ 30mbar in 1992. The standard error in the measurement was 0.018 m3/hr/km @ 30mbar compared with 0.032 m3/hr/km @ 30mbar in 1992. Whilst in absolute terms the standard error was lower, the 90% confidence interval expressed as a percentage of the total value was greater than expected at ±19.4%.

Overall, the weighted average pipe leakage factor was almost half of the value that it was in 1992. This was principally due to the increased relative length of polyethylene (PE) pipe in the mains population, with a result of the replacement of metallic pipe. In addition the measured leakage performance of the pipe asset had improved in the more significant material strata.

These results were further reviewed by the Industrial Statistics Research Unit [31]. In this report ISRU concluded that the sample used gave a good representation of the mains across the population, and the uncertainty of the estimate was reflected in the ±19.4 % confidence interval.

The ISRU report, Haswells report and the leakage test report were all published to the industry in 2003 and are re-published alongside this 2nd Draft of the AUGS for reference.

Without testing the entire distribution network there will of course be an error associated with the leakage rates using the sample which has been established and independently verified. The AUGE believes that the assessment of Leakage rates carried out in 2002/3 remains a robust estimation of leakage rates.

In the calculation of this element of Shrinkage, the leakage rates arising from the tests are used in conjunction with each GT's service population and ultimately throughput to calculate the leakage volumes.

In 2009 a further modification was made to the leakage estimate calculation to allow for changes in the pipeline population – i.e. to take account of the service pipeline replacement program that each GT undertakes.

Each year the GTs estimate the number of replacements that they are going to implement and initial leakage calculations are based on these estimates. The final Shrinkage figures are revised after the year based on what actually changed. In 2009 GL Noble Denton were commissioned by the Energy Networks Association to carry out an independent review of the Leakage model [33]. This compared the proposed new calculation method (known as Version 1.3) with Version 1 of the model. The new model identified service replacements undertaken since the previous years leakage estimate was made, and therefore provided a better reflection of population change over time.

The review noted that the new method was correctly applied and would account for annual leakage reduction from service replacements. Hence the new method better reflects the level of leakage as the service pipe population changes.

Earlier versions of the model (such as NLRMM V2.7) used fixed percentages for the service type population. Later versions of the model (Version 1 and onward) used a length weighted proportion. Furthermore, the proposed model change only included the impact of service replacements since 2006/7. In addition, the leakage model does not account for the reduction effect of cutting off services to demolition properties that may be in the categories 'metal service connected to metal main' or 'PE service connected to metal main'.

There may therefore be elements of the service pipe population estimate that do not reflect reality, but there is no way of knowing exactly what this difference might be without examining the entire population. There may also be over statements of leakage by not accounting for demolition sites.

What we can conclude, however, is that the leakage model does account for changes in the service pipe population and will better reflect leakage levels that previous models did. Comparing models used on 2007/8 data showed a reduction in leakage of ~25GWh over 2 years replacement.

In terms of the reliability of the leakage model, the following questions relate to the requirement in this area:

1. Are the leakage rates reliable?
2. Does the record of replacing pipes in the ground as reported by the GTs match what actually goes in the ground (when the GTs finalise their leakage figures)?
3. To what extent does the omission of demolition sites have on leakage?

Given the rigorous assessment of the sampling, collection and analysis of results carried out in the National Leakage Survey 2002/3, and the assessment by ISRU, the AUGE believes the leakage rates used by the GTs for the calculation of Shrinkage are reliable and unbiased.

The leakage rates have a 90% confidence interval of ±19.4%, which means that we can be 90% confident that the true leakage rate lies between ±19.4% of the estimated value.

Regarding the record of what is in the ground, there are some potential historical inaccuracies which cannot practically be assessed without physical inspection of the entire population. In terms of replacements going forward, without inspecting pipes reported to have been replaced we have to rely on the information provided by the GTs in the Shrinkage proposals.

Demolition sites are unlikely to result in significant biases in leakage, although the Shrinkage Forum may wish to consider to what extent these impact leakage rates.

6.3.1.2 AGIs

GL Noble Denton carried out an assessment of gas losses from AGIs (Above Ground Installations) in 2003 [34].

This includes losses from low pressure gas holders, district governors, service governors and pressure reduction stations. A monitoring programme across a sample of AGIs was implemented and the results verified by independent consultants. The University of Nottingham assessed the gas measurement instrument design and operation, test and calibration results [36]. Their assessment was that the accuracy of measurements was in the order of 5-10%.

The Industrial Statistical Research Unit (ISRU) also reviewed the statistical analysis carried out [35].

This resulted in an estimation of AGI emissions with a 90% confidence interval ±16.5% of the mean for the predicted total emissions for the total asset type (when data was analysed by holder; confidence interval was ±16.9% when analysed by holder station).

ISRU confirmed that the sample used provided a good representation across the populations of AGIs and that there was no evidence of bias due to the sampling or methodology of the tests. Overall the test programme was found to be a reasonable compromise between producing reliable results and testing every AGI.

6.3.1.3 OUG

Own Use Gas is the gas consumed by hot water bath pre-heaters at pressure reduction stations. Such heaters are employed to avoid the physical effects of ice formation in cold weather when the reduction in pressure of the gas induces a significant reduction in gas temperature.

In 2002 GL Noble Denton reviewed an existing National Grid OUG model and implemented an improvement plan to calculate OUG for all NTS and LTS pre-heaters [37].

Concerns were raised by the Shippers in 2006 that the analysis in 2002 was becoming out of date and that the results were not applicable to other years. The Shrinkage Forum requested GL Noble Denton to carry out a sensitivity analysis of the 2002 model to assess its suitability for other years. Then, depending on the results a decision could be taken whether the existing model was fit for purpose or not.

The analysis [17] applied statistical extremes to the input variables used in the 2002 model [38] and calculated the effect on the OUG output.

The key inputs to the model were

- Flow through the heater (F1)
- Outlet temperature, post pressure reduction (T1)
- Ground Temperature
- Inlet Pressure (P1)
- Outlet Pressure (PS)

Specific gravity and density of air are applied as constants within the model. In addition, assumptions were also made about the heater efficiency (E).

The conclusions of the sensitivity analysis indicated that of the above variables, variations in ground temperature (supplied to the model as a monthly figure) would be most likely to lead to changes in calculated energy. Given that ground temperature changes slowly, however, the data frequency was less critical for this variable.

In addition, due to climate change effects current gas temperatures (as at the time of the review in 2006) were likely to be higher than those in 2000 and hence lead to a lower estimate of OUG.

Heater efficiency has a direct effect on energy consumption and percentage OUG, but it is not the most important variable in terms of the impact on the output of the OUG equation. The assumed heater efficiency used in the model was and still is set at 50%, although there are a number of papers and tests/reports [38] that demonstrate heater efficiencies in excess of 60% are possible with regular tuning and maintenance (see Figure 12 below).

Report	Conclusion
MRS I2912 Efficiency Tests on Water Bath Heaters at Coleshill AGI	The indirect method gives the efficiency as found for H5 as 66.5% and for H6 as 58.0%.
MRS N392 Methods of Improving the Thermal Efficiency of water bath heaters	The test work has shown that the efficiency of the heater, as delivered, can be between 62% and 69% according to the settings of gas pressure and primary aeration.
MRS N403 The Thermal Efficiency of Water Bath Heaters at Alrewas A.G.I	The gross thermal efficiency of the heater, as delivered, lay between 53 and 66% depending on the thermal input and the primary aeration level set at the burner.
MRS N 458 Performance Testing of Water Bath Heaters	At 61%, the heater efficiency was well below the manufacturers stated 70% figure.

Figure 12 – Pre-heater efficiency tests

Based on this information, it is possible that the heater efficiency used in the OUG model potentially overstates the amount of OUG by as much as 10-20%. This potentially offsets the effect of ground temperature assumptions. However, further data and analyses would be required to establish the exact magnitude of this in terms of actual bias, if any exists.

it should also be noted that OUG makes up a very small percentage of Shrinkage and the effects of its error are likely to be small relative to the Shrinkage Error, and indeed the error in estimating Unidentified Gas overall.

6.3.1.4 Theft of Gas

The shrinkage proposals for 2011-12 use a Transporter-responsible theft of gas factor of 0.02%. This figure is taken from the UNC, but there is no detailed information on how it is arrived at and to what extent it reflects reality.

Biased errors of theft could affect Shrinkage Error, but there is no reliable data to prove this either way. This is an area that is under review both in the Shrinkage Forum and Theft of Gas Forum as mentioned in the Scotia Gas Network Shrinkage proposals for 2011/12 [28].

6.3.1.5 Summary

If Shrinkage is considered as a whole, the key component is Leakage, followed by AGIs. The estimates of these components have 90% confidence intervals of ±19.4% and ±16.9% respectively and there is no evidence to suggest the models are biased, as confirmed by the independent consultant reports. Further analysis would be required to establish what range of errors would be expected for other confidence intervals.

There is potential for bias in the OUG model (although this is relatively small compared to the potential error in Unidentified Gas overall). The AUGE also notes that some GTs are implementing metering on their Hot Water Baths, which will over time reduce the risk of OUG errors.

The AUGE concludes that the analyses that have been carried out over the years are statistically sound and have been independently verified.

There are of course aspects of the different models that could be improved to make the estimation of Shrinkage more accurate, and these are highlighted in the various reports. The AUGE believes this is the remit of the Shrinkage Forum, however.

As described previously, the UG methodology incorporates the effect of shrinkage error within the Balancing Factor regardless of whether any bias exists within it.

6.4 Unregistered and Shipperless Sites

The AUGE believes that both Unregistered and Shipperless sites should be included in the Unidentified Gas estimate. These types of gas arise from different sources and hence require different analyses in order to estimate them accurately. Therefore Unidentified Gas sources in this area are grouped into elements that respond to similar drivers, and each group is described separately below. In addition to splitting by category, it is also necessary to split the UG estimate by SSP and LSP market sectors and to carry out separate calculations for each. In each case, the calculations for SSP and LSP are carried out in the same manner, using the data appropriate to the market sector in question.

Xoserve supply data to the AUGE where Unregistered and Shipperless sites are split into seven categories, as follows:

- Shipper Activity
- Orphaned
- Shipperless Sites (Passed To Shipper)
- Shipperless Sites (Shipper Specific rePort)
- No Activity
- Legitimately Unregistered
- Created <12 Months

Each category is split between "Small AQ" and "Large AQ" (with the split threshold at the SSP/LSP level of 73.2MWhpa), and the number of sites in each category is recorded. In addition, where appropriate the data is split between sites believed to have a meter (and are thus capable of flowing gas) and those believed to have no meter (and hence cannot flow gas), and both aggregate AQs and the number of sites are recorded for each.

This information is supplied on a two-monthly basis in the form of the "Unregistered and Shipperless Sites Report", which was created by Xoserve specifically for this purpose. This contains all the data described above, split by category. Each annual calculation of Unidentified Gas is based on seven consecutive instances of this report, as follows:

- Six reports to cover the 12 months of the year being analysed.
- One further report pre-dating the first report of the year representing starting conditions.

This is shown graphically in Figure 13. Arrangements have been made with Xoserve for snapshots to be provided every two months, and for each UG calculation the relevant set of snapshots relating to the time period of interest will be used. It should be noted that at this stage we do not have a complete set of snapshots, due to the fact that they cannot be produced retrospectively. The AUGE has therefore used as many snapshots as possible, and where they do not exist, the oldest snapshot has been repeated.

Typical contents of the Unregistered and Shipperless Sites Report for the “Shipperless – Passed to Shipper” category are shown in Table 4 below:

TABLE 4: EXAMPLE SHIPPERLESS SITES SNAPSHOT DATA

LDZ	Small Supply Point	Total AQ Value	Large Supply Point	Total AQ Value
EA	96	1,177,688	6	944,521
EM	90	1,229,066	5	601,301
LC	1	1	0	0
LO	0	0	1	314,280
LS	0	0	0	0
LT	0	0	0	0
NE	34	433,652	4	698,689
NO	41	705,623	3	891,670
NT	142	2,406,276	12	2,729,470
NW	108	1,481,265	9	1,795,433
SC	185	2,447,118	13	4,346,438
SE	196	2,965,091	22	4,427,406
SO	124	1,226,012	12	1,976,493
SW	45	806,546	5	2,417,886
WM	67	768,477	7	1,173,366
WN	33	599,440	2	255,271
WS	63	732,422	3	3,616,303
Total	**1,225**	**16,978,677**	**104**	**26,188,527**

As reports are two-monthly, each covers a different time of year, and typical annual flow patterns show that on average a different proportion of AQ is likely to be consumed in each of these periods. Therefore, when carrying out Unidentified Gas calculations, an average annual profile is required in order to obtain the relevant proportion of the AQ consumed in the period in question. Depending on the time period covered, this profile is also shifted to ensure alignment with the time of year.

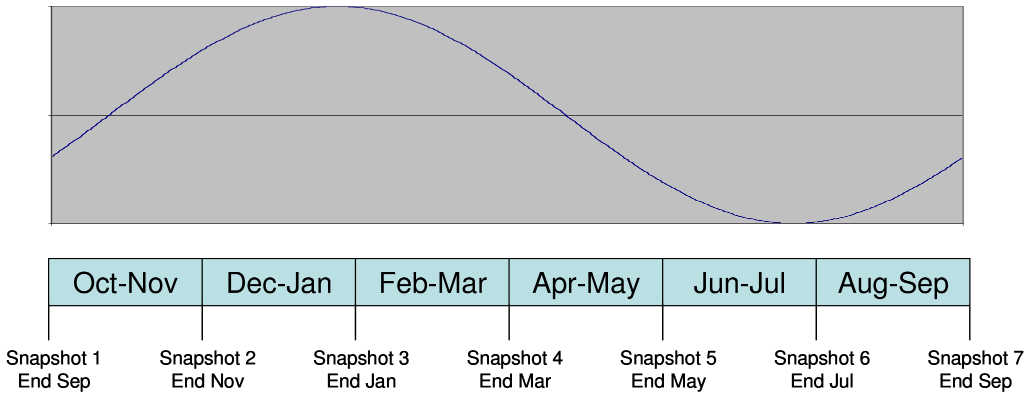

Figure 13 – Shipperless Sites Snapshots

Known LSP load data was used to construct the AQ consumption profile, and results are shown in Table 5 below. Proportions from this table are applied to the calculated contributing AQs arising from each snapshot to give the estimated consumption in those two months only for each element of the Unregistered/Shipperless Sites calculation.

TABLE 5: 2-MONTHLY CONSUMPTION PROFILE FOR LSP LOADS

Snapshot Period	AQ Percentage
Oct-Nov	18.9
Dec-Jan	28.0
Feb-Mar	25.0
Apr-May	14.6
Jun-Jul	6.5
Aug-Sep	7.0

6.4.1 Shipper Activity/Orphaned Sites

The total figure for Shipper Activity/Orphaned Sites covers all new sites that have an MPRN and appear in the Sites & Meters database but are not registered to a shipper. Only those that have a meter are capable of flowing gas, and so for this category the number of sites and aggregate AQ data is split into the "believed to have meter"/"believed to have no meter" groupings in the datasets provided by Xoserve.

The summarised data supplied to the AUGE for these categories means that the change in the number and AQ of sites of this type can be tracked over time, but the rate movement of sites in and out is unknown. Therefore, for example, if there were 100 sites in Month 1 and 120 in Month 2, the latter figure could be composed of anything between the same 100 sites plus 20 new ones, or 120 new sites, with the original 100 all having now been associated with a shipper.

Under either scenario, it is reasonable to assume that the rate of change is steady (i.e. new sites coming in and existing sites going out), and if this assumption is made, the average composition of the category during the two-month period in question is always the average of the month-start and month-end figures:

Average Sites = (Starting Sites + End Sites) / 2

Therefore this technique is used to calculate the average number of sites and AQ during each period. Only sites believed to have a meter are included in this calculation. It is also possible that some sites enter and leave this category between snapshots and so are not picked up at all. The number of such sites is likely to be small and their contribution will also be small as they will have been consuming gas only over a short time period.

It is also recognised that not all new sites that are capable of flowing gas (i.e. those with a meter) will actually be doing so. Therefore, the second stage of the analysis for this category of UG is to estimate the proportion of sites with meters that are taking gas. This is done by examining the opening meter readings of all sites that were previously classed as orphaned before becoming registered with a shipper. Those that have a non-zero opening read (or a meter read larger than a small threshold value to discount situations where the meter has recorded insignificant flows whilst not registered to a shipper) are viewed as having taken gas before being registered. The proportion of sites where this has happened is then applied to the "believed to have a meter" category and the gas flow calculation carried out only on this subset. This analysis of opening meter readings is based on data supplied by Xoserve and found 36.8% of sites had been flowing gas.

The final flow calculation for the subset of sites believed to have a meter and to be flowing gas is carried out using the aggregate AQ, profiled for the time of year using the figures from Table 5.

6.4.2 Shipperless Sites (Passed To Shipper and Shipper Specific rePort)

The figures for this category in the Unregistered and Shipperless Sites report represent those sites that have been shipperless for more than 12 months, and have been visited and found to still be flowing gas. Passed To Shipper sites are those where the old meter is still in place, and Shipper Specific rePort (this is often abbreviated at the SSP report which can be confused with the Smaller Supply Point acronym – they are different entities hence form of the word report in this case) sites are those with a new meter. As the UNC currently stands there is no process of backbilling for either type of site, and so all gas consumed is Unidentified Gas. Mod 369 [2] will result in all Passed To Shipper sites being backbilled and hence these will no longer contribute to Unidentified Gas if this modification is adopted. Shipper Specific rePort sites will not be covered, however, and so will still contribute.

The figures for the number of sites and the aggregate AQ of those sites can be used directly in the calculation of Unidentified Gas from this source. For both PTS and SSrP categories, an AQ profile is applied as it was for Shipper Activity/Orphaned sites.

It is also important to note that the sites recorded here do not represent all shipperless sites that are still flowing gas – just those that are older than 12 months and have been visited. In addition to this, a number of sites will have been shipperless for less time but still be flowing Unidentified Gas. It is therefore important to obtain information for all shipperless sites, including those that have been shipperless for less than 12 months. This data should include both the number of sites and aggregate AQ. This data has been requested from Xoserve and is awaited.

Not all shipperless sites that are less than 12 months old will be flowing gas, as many will be vacant sites, etc. The proportion of sites that have been shipperless for less than 12 months and are actually flowing gas is estimated from Gas Safety Visit data. This records the number of sites visited and the number found to have a meter and to be flowing gas. This proportion is then applied to the "Shipperless <12 Months" population to create an estimate of the number and aggregate AQ of sites in this category consuming Unidentified Gas. As in other cases, an annual profile is applied to the AQ values to estimate the volume consumed in each two-month period.

This part of the shipperless sites analysis cannot be carried out with the data that has been supplied so far. Therefore, results from this element of the UG calculation presented in Section 7 below are only for PTS and SSrP sites.

6.4.3 No Activity

Sites in this category are currently being processed and will end up in one of the other categories. These are therefore split between the other shipperless/unregistered categories pro-rata prior to the analysis for each taking place.

6.4.4 Legitimately Unregistered

These sites are believed to have no meter, and hence are not capable of flowing gas. Therefore this category does not contribute to Unidentified Gas.

6.4.5 Sites Created < 12 months

Sites are only reported in the Shipper Activity and Orphaned categories once they have been in existence for 12 months and have remained unregistered for that time. Unregistered sites that have existed for less time than this may still be flowing gas and hence contributing to Unidentified Gas despite the fact that they will not be investigated until they have been unregistered for 12 months. Therefore they need to be included in calculations.

For this category, the number and AQ of sites with and without meters are not recorded, and so the proportion that have a meter and can be assumed to be flowing gas is taken from the equivalent data for Shipper Activity/Orphaned sites. This approximation aside, these sites are exactly the same as Shipper Activity and Orphaned sites, and so the calculations are carried out in the same manner.

One potential difference between <12 Month sites and Shipper Activity/Orphaned sites is that as <12 Month sites are new, they may be ramping up flow and not taking at their AQ level. An analysis of a sample of meter reads from new LSP sites has shown no significant ramping up effect, however, and so it has been concluded that it is valid to calculate flows based on the profiled AQ for this category of site, in the same way as for other categories.

6.5 IGT CSEPS

Connected System Exit Points (CSEPs) are typically small networks owned by Independent Gas Transporters (iGTs) that connect to the GTs' systems. They are often new housing estates, where the gas network for the estate has been built and is owned by an iGT. CSEPs can potentially contribute to Unidentified Gas where either loads within them or entire iGT networks are not recognised by the Xoserve system and are thus taking gas in an unrecorded manner.

Regular meetings are held between then iGTs and Xoserve with regard to Unknown Projects (ie CSEPs that are not registered on the Xoserve system), and a regular report is produced. Xoserve have put systems in place in order to report not only the number of Unknown Projects but also their composition in terms of number of sites and aggregate AQ. This report is produced every two months and supplied to the AUGE. The composition of Unknown Projects is not split by EUC or SSP/LSP market sector, and therefore this split has to be estimated from other data.

Xoserve have also provided a breakdown of known CSEPs, with a split between known sites on known CSEPs and unregistered sites on known CSEPs. Both of these data sets are split by EUC, and can hence be aggregated up to SSP/LSP level. For each EUC, both the number of sites and the AQ is reported.

The contribution of unregistered sites to LSP UG is simple to calculate using this information, and in addition the average composition of known CSEPs (in terms of percentage SSP/LSP split) can be used as a basis for splitting Unknown Projects into their market sector components. This also allows LSP UG to be calculated for Unknown Projects, which completes the calculation of LSP UG from this category.

6.6 Shipper Responsible Theft

Transporter-responsible theft (i.e. theft that takes place upstream of the Emergency Control Valve) is contained in the LDZ Shrinkage calculation and hence is not a part of Unidentified Gas.

Statistics for shipper-responsible theft (both alleged and proven) are held by Xoserve and have been supplied to the AUGE. These consist of a database with one record per theft allegation, with a record of estimated kWh stolen and a flag for whether the theft was proven or not.

The problem with calculating theft levels is that the true level is unknown. Detected thefts and alleged thefts are recorded, but the nature of theft means that many instances of theft are never detected or alleged, and so there is an addition category – unknown theft – which is of unknown size. Anecdotal evidence suggests that unknown theft could be as high as 10% of throughput, although the AUGE has not seen any evidence to support this. Previous initiatives to assess theft and improve detection have been carried out, and Mods 274 [10], 277 [11], 346 [12] and Theft of Gas "next steps" [8] provided detailed analysis of the situation and various information pertaining to theft. In particular there was little evidence and few propositions regarding unknown theft.

Given this lack of information about theft levels it is very difficult to make a robust direct calculation of the amount of Unidentified Gas that can be attributed to this source. Any such calculation requires an assumption to be made about unknown theft, and whilst a reasonable assumption can be made there will never be any data to back it up.

Therefore the decision has been taken to calculate theft by subtraction as part of the Balancing Factor. The result of this approach is that the theft estimate is far more robust due to the fact that it is dependent on factors that have good quality data associated with them and can therefore be estimated far more accurately. By ensuring that all sources of UG are included in the calculation, the elimination of the other elements leaves theft as the source of the remainder.

This approach allows a total figure for theft to be calculated, but does not address the issue of splitting this between the SSP and the LSP markets. Analysis of detailed theft data from 2006 to 2010 shows that the proportion of *detected* thefts that arise from the SSP market is very similar to the proportion of *alleged* thefts that arise from this market sector. It is therefore reasonable to assume that this figure is an accurate representation of the split between market sectors in terms of the relative frequency of thefts. This data shows that 95.4% of occurrences of theft come from the SSP sector. LSP thefts typically involve larger volumes of gas, however, and taking this into account, the proportion of theft volume that arises from the SSP sector is 92.1%.

This value can be used to split the calculated total theft volume between the SSP and LSP markets.

6.6.1 Responses to AUGE questions regarding Theft initiatives and site visits

Earlier in the methodology development the AUGE posed a number of questions to the industry regarding theft. The responses are summarised in this section.

Unidentified Gas due to theft is a key issue and is difficult to accurately estimate due to the lack of reliable data in this area. Various methods of estimating theft have been proposed in previous modifications (e.g. Mod 194/228), but agreement had not been reached at this stage.

There are different views on levels of theft within the industry. Some industry bodies believe theft is much higher that the detected rates show and that unknown theft is significant, whilst others believe that it is much lower and closer to the level of detected theft.

The initial approach of the AUGE in this area was to investigate detected and alleged theft levels, to determine reporting rates and identify evidence from the market related to meter inspections. The proposed approach was then to devise a theft estimate that incorporated all of this information. Given the limitations of this method, an alternative approach was subsequently identified to estimate theft by subtraction as the major component of the Balancing Factor, as described in other sections of this document.

To help understand theft detection rates and potential for theft, the AUGE raised three questions with the industry regarding theft, and a fourth concerning sites without a MPRN.

The AUGE received responses from 12 industry bodies. Note that numbers of SSP/LSP sites and customer numbers have been aggregated as this information is commercially sensitive for each organisation that responded.

In addition, responses did not all carry the same level of detail, so it is not necessarily the case that if one respondent reported carrying out certain activities that no one else did – they might also, but simply not included that level of detail. In the responses the AUGE shows this with "at least N respondents said….".

1. What (if any) initiatives have you implemented to identify theft, and if so, when were they introduced? If these initiatives were only temporary, when did they stop?

- At least 5 respondents report they have dedicated teams of different sizes to provide a proactive approach to theft detection.
- At least 1 respondent installs smart meters as part of their business strategy and believes this reduces the risk of theft as the consumption can be closely monitored.
- At least 5 respondents contract their Meter Reading Agents [MRA] to inspect meters for theft in addition to taking meter reads. Suspected cases are reported back and investigated. In addition, cases notified by Xoserve on Conquest are also investigated.
- At least 3 respondents investigated interference reports to determine whether a genuine theft has occurred or a metering error.
- At least 1 respondent also reviewed AQ amendment requests that result in excessive changes to AQ to ensure that there is a genuine change in consumption patterns or whether this is due to theft.
- At least 2 respondents have been rolling out AMR technology to remotely monitor consumers' sites regularly and at a greater granularity to help identify unusual patterns and potential theft.
- At least 1 respondent did not have a revenue protection team and relied on their credit team and its agents to investigate potential theft, but believed their business model reduced risk of theft.
- At least 1 respondent provided details of a number of initiatives including tip off lines, forensic meter testing, and investigating/profiling data to identify unusual patterns.
- At least 1 respondent investigates all theft allegations and employ an expert to inspect potential theft cases.

2. **Shippers are required to visit/inspect meters every 2 years. The AUGE requested statistics on the number of customers that have not been visited in the last 2 years, split by LSP/SSP groupings. The total number of LSP/SSP customers currently prevailing was also requested, and therefore reporting is in non-specific Shipper terms as per AUGE Guidelines.**

The majority of respondents provided a summary of the total number of sites split by LSP/SSP and the number of outstanding visits. The totals are summarised in Figures 14 and 15. Figure 14 shows the total number of site visits outstanding for SSP and LSP market sectors. The second table shows the percentage of site visits outstanding as a percentage of the total number of sites.

SSP Site visits outstanding	LSP Site visits outstanding
216263	2067

Figure 14 – Total number of site visits outstanding in last two years

Number SSP Site visits outstanding as % of total*	Number LSP Site visits outstanding as % of total*
1.59	1.03

Figure 15 – Number of site visits outstanding as percentage of the total number of sites

* Note that not all respondents provided the total number of sites, so the percentage is based on data from those respondents that provided both.

- It was noted by at least 1 respondent that they had visited all sites, but the number of outstanding sites was due to those sites where access could not be achieved.
- At least 3 respondents reported that they did not have any customers that haven't been visited in the last two years
- At least one respondent noted that of the sites that had not been visited in two years, a proportion of them turned out to be vacant, redeveloped or boarded up.

3. **Additional information on theft (over and above data requested by the AUGE from Xoserve) that the Shippers believe may be relevant to this subject was also requested.**

- Five respondents had no additional information on this question.
- At least 3 respondents noted that AMR was becoming more common and a portion of their LSP market was using AMR technology. They noted that the higher granularity and availability of data would be expected to show suspicious consumption patterns more readily. They had not seen any evidence of theft.
- At least 2 respondents believed that if theft is taking place, the customer is unlikely to change supplier (since the new supplier may have a different monitoring policy) plus they would need to have a meter reading obtained during changeover. It was also suggested that historic theft of this type is more likely to remain with the original incumbent supplier.
- At least 2 respondents noted that a large proportion of their portfolio was made up of large blue-chip companies and public sector bodies which would not expect to be involved in theft.

- At least 4 respondents proactively credit check potential business customers as part of the contracting process and therefore believe their customers are less inclined to theft.
- At least 2 respondents noted that they are supporting a new initiative to introduce a National Revenue Protection Service for all shippers.
- At least 1 respondent provided information on examples of meter tampering which was very informative.
- At least 1 respondent believed that known theft levels cannot be used reliably as an indicator for true levels of theft and provided a number points to support that argument.

4. It was suggested by shippers at the industry meeting held on 9th March 2011 that sites may exist, have a meter and take gas without being registered and without an MPRN. The Shippers were asked to provide any further data and evidence that they may have on the likely number of sites and AQ levels involved.

- At least 7 respondents reported that they had not encountered this situation or stated that shipperless and unregistered sites would be unknown to them and that this information would be with Xoserve and/or the GTs.
- At least 3 respondents had encountered this situation occasionally but did not have any meaningful data on the subject.
- At least 2 respondents provided examples of when this occurs for them.
- At least 1 respondent highlighted that a root cause was typically a builder not notifying a Transporter due to an admin error, or a supplier erroneously deleting a MPRN believing it to be duplicated. The respondent also noted examples of illegal connection that the GTs or Shippers were unaware of at the time.

6.7 Metering Errors

Metering errors (at both the LDZ entry points and the supply points) can have an effect on the calculated loads for each market sector if there is found to be a non-zero bias over time. The impact of such biases and the method of incorporating them into the RbD process should they exist is dependent on the type of meter in question:

- Errors in LDZ offtake meters and DM supply point meters affect the RbD calculation directly and should be dealt with at this point rather than in the Unidentified Gas calculation. Despite this, the AUGE can still estimate such volumes should they exist, and so an assessment of this area of metering error has been carried out.
- Errors in SSP supply point meters do not affect RbD or the Unidentified Gas estimate because SSP supply point meter reads are not used in the calculations.
- Errors in NDM LSP supply point meters can cause gas to the burnt in an unrecorded manner (in the event of an NDM LSP under-read) and hence have the potential to contribute to Unidentified Gas. An assessment of this area of metering error has therefore been carried out.

The GL Noble Denton Metering Team were asked to provide input for the analyses identified above, and the conclusions drawn in this section come from them. The following conclusions were drawn from the investigation:

- Very little work has been done in the field of accurately assessing meter drift over time. Information is available about calibration curves taken at a particular point in time for certain meters, but there has never been any dedicated work looking at how these change over time. Therefore, conclusions drawn in this area are largely based on anecdotal evidence and/or extrapolation.

- Smaller sites (i.e. SSP loads and smaller LSP loads) typically have diaphragm meters. The rubber diaphragm is known to warp over time, which causes drift in meter readings. Available evidence suggests that drift is equally likely to be up or down, resulting in a net bias of zero across the population.
- Larger sites and offtakes generally have rotary/turbine meters that are constructed of metal and are unlikely to warp over time. These drift less than diaphragm meters, and again are equally likely to drift up or down, resulting in a net bias of zero across the population.
- Where large errors requiring a major ad-hoc adjustment are found, these are far more commonly under-reads than over-reads. When such an error is found, however, RbD is credited with the (approximate) value of the error and so detected errors have a zero net impact over time. it is reasonable to assume that no such errors carry on indefinitely, and that all are corrected (and hence RbD credited) at some point. Therefore there is no net contribution to Unidentified Gas from this source.
- Calibration curves for for both diaphragm and rotary/turbine meters follow a similar pattern. Such a curve for an NDM LSP RPD meter is shown in Figure 16 below.

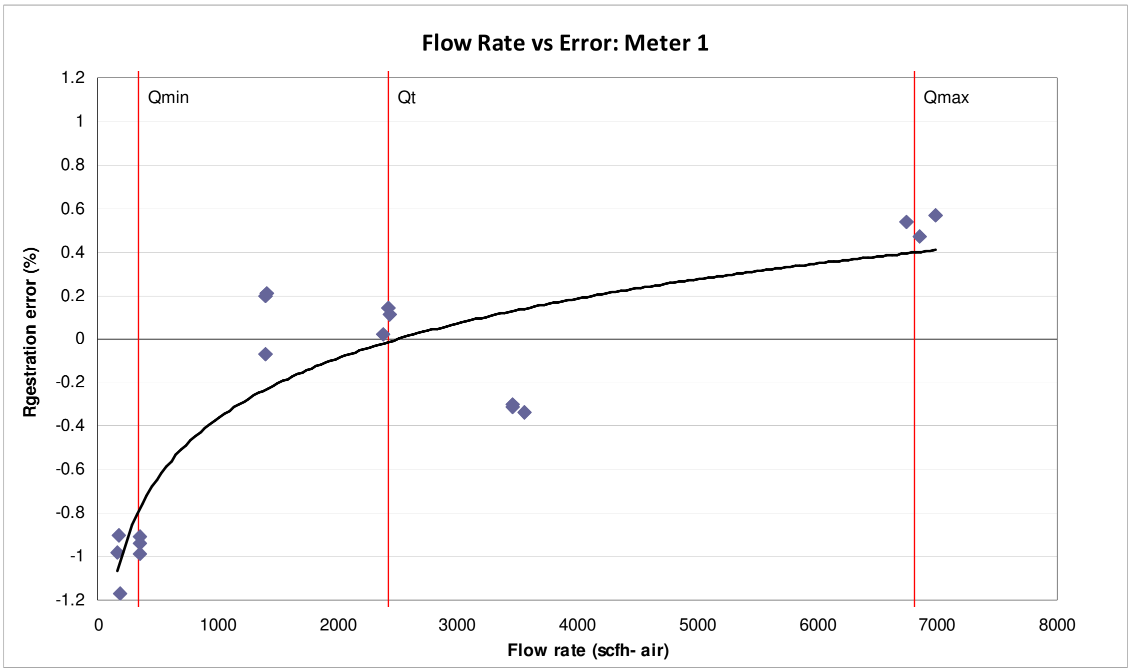

Figure 16 – Typical Calibration Curve for an RPD Meter

Data for this graph was provided by the GL Noble Denton metering team and comes from laboratory testing of a typical RPD meter. All identifying information has been removed for confidentiality purposes.

- The prominent features of this calibration curve are a consistent under-read of 1%-1.5% when operating at or below Q_{min}, unbiased readings around Q_t, and a consistent over-read at or close to Q_{max}.
- Meters are designed to operate at or around Q_t, ensuring that unbiased readings are obtained. This is not always the case, however, and circumstances may arise that cause some meters to operate close to Q_{min} or Q_{max}.
  - loads at a particular site can drop over time, either due to changes in gas usage or because of economic conditions. This can leads meters to operate consistently close to Q_{min}.
  - where businesses expand their operations without informing their gas supplier, the meter may no longer be appropriate for the load, causing it to run at or above Q_{max}.

Based on the above conclusions, an assessment of likely meter operating zones was carried out. Available data was limited to the meter capacity and AQ of each LSP site, and this required the AQ to be used to estimate average hourly load, which could then be compared to meter capacity. This translation from annual load to hourly load necessarily introduces uncertainty into the analysis, but the comparison of average hourly load and meter capacity allows those meters that are likely to be operating at their extremes to be identified.

- Sites with an average hourly flow of less than 1% of meter capacity were considered to be likely to be operating at or around Q_{min} when gas was flowing. These were assumed to be operating with an average under-read of 1.5%.
- Sites with an average hourly flow of more than 95% of meter capacity were considered to be likely to be operating at or around Q_{max} when gas was flowing. These were assumed to be operating with an average over-read of 0.5%.
- The effects of under-reads and over-reads work in different directions, and the difference between then represents the net over- or under-read in the population. This figure was calculated for each LDZ, and results are given in Section 7 below.

6.8 Unknown Sites

These are sites that are unknown to the Xoserve system because they are taking gas but do not even have an MPRN. It is known that a small number of such sites exist, but there is little evidence concerning their likely prevalence and magnitude. The AUGE requested data on this subject from Xoserve and the Shippers, and the data received in return suggests that any contribution to Unidentified Gas in this area is negligible. Therefore the decision has been taken to remove it from the analysis.

6.9 Worked Example

In order to illustrate how the above techniques are applied in practice, the following worked example is provided for EA LDZ. This shows how each element of Unidentified Gas is calculated and how it contributes to the final total. Full results for all LDZs are then provided in Section 7.

The Unidentified Gas calculation takes places in stages, as follows:

1. Calculation of average RbD bias. This is currently calculated over the formula years 2007 to 2009 due to availability of allocation algorithm data and the need for consistency in time periods between data sources. Average RbD bias for EA LDZ during this time period is 1166.0 GWh per annum.
2. Algorithm bias is then calculated using the techniques and formulae described in detail in Section 6.2 above. For EA LDZ for the same time period, algorithm bias due to AQ change is calculated as 209.7 GWh per annum.
3. The difference between these two figures is the total Unidentified Gas assigned to the LSP sector by the allocation process. Note that although this gas has been *assigned* to the LSP sector, it can *arise* from both SSP and LSP, and the split between the market sector source of the UG in question is calculated later in the process. LSP assigned UG for EA LDZ is therefore calculated as follows:

   LSP Assigned UG = 1166.0 GWh – 209.7 GWh = 956.6 GWh per annum.
4. The next stage of the process is to calculate the directly estimated components of Unidentified Gas. This is done separately for SSP and LSP, thereby giving a breakdown by market sector as well at the total for each component.
5. The iGT CSEPs calculation is based on data provided by Xoserve in the Unknown Projects Summary, along with information about live and unregistered sites on known CSEPs. Figures are as follows for EA:

Unknown Projects = 97
Supply Point Count = 1218
AQ Total = 16.3 GWh

From known CSEPs in EA LDZ:

SSP Supply Point proportion = 99.7%
LSP Supply Point proportion = 0.3%
SSP AQ proportion = 82.7%
LSP AQ proportion = 17.3%

These figures are used to split the unknown project supply point count and aggregate AQ by market sector:

For unknown projects:

SSP Supply Points = 1214
LSP Supply Points = 4
SSP AQ = 13.5 GWh
LSP AQ = 2.8 GWh

Data regarding unregistered sites on known CSEPs is supplied by Xoserve and is as follows:

SSP Supply Points = 3513
LSP Supply Points = 7
SSP AQ = 42.6 GWh
LSP AQ = 0.12 GWh

Total UG from this source is the combination of these two, plus a proportion of 9 unknown projects with unknown LDZ smeared across all LDZs:

SSP Supply Points = 4753
LSP Supply Points = 11
SSP UG = 56.4 GWh
LSP UG = 3.0 GWh

6. Shipperless and Unregistered sites are split into six categories. In the tables in Section 7, the components are shown in grey, and the combined sum of these in black. Calculations for each category are very similar, so a single typical example - LSP Shipper Activity Sites - is given here.

   Site count and AQ data is supplied in the two-monthly snapshot files. Figures for EA LDZ are:

   Snapshot 1 AQ: 0.6 GWh
   Snapshot 2 AQ: 0.7 GWh
   Snapshot 3 AQ: 3.5 GWh
   Snapshot 4 AQ: 3.5 GWh
   Snapshot 5 AQ: 3.5 GWh
   Snapshot 6 AQ: 3.5 GWh
   Snapshot 7 AQ: 3.5 GWh

   Note that at the current time only 3 snapshots exist. Xoserve cannot produce them retrospectively and so the oldest snapshot has been repeated so that a full year is covered.

The gas consumed between snapshot x and snapshot y is calculated as the average AQ across these two snapshots, multiplied by the appropriate factor from Table 5 to reflect the time of year:

Snapshots 1-2: Average AQ = 0.67 GWh
Time of year factor = 0.0649
Percentage of orphaned/shipper activity sites with non-zero opening reads = 36.8%
Gas consumed = 0.67 GWh * 0.0649 * 36.8% = 16,054 KWh

Similar calculations for the remaining snapshots give the following consumptions:

Snapshot 1-2: 16,054 KWh
Snapshot 2-3: 113,723 KWh
Snapshot 3-4: 320,722 KWh
Snapshot 4-5: 360,391 KWh
Snapshot 5-6: 242,866 KWh
Snapshot 6-7: 89,698 KWh
Total: 1.14 GWh

Calculations for each other category of Shipperless or Unregistered site are similar. Note that it has not been possible to calculate UG from the "Shipperless <12 Months" category due to data still being outstanding, and so the tables have been populated with zeros for this category.

7. For meter errors, sites with an average hourly consumption (calculated from the AQ) of 1% or less of their Q_{max} value are considered to be consistently operating in the "under-read" area. Sites with an average hourly consumption of 95% or more of their Q_{max} value are considered to be consistently operating in the "over-read" area. The average levels of under-read and over-read are taken from calibration curves, an example of which is given in Figure 16.

   Average under-read: 1.5%
   Average over-read: 0.5%

   Total sites in under-read zone for EA LDZ: 4999
   Aggregate under-read: 1.89 GWh

   Total sites in over-read zone for EA LDZ: 4
   Aggregate over-read: 0.14 GWh

   Net contribution to UG: 1.89 GWh – 0.14 GWh = 1.75 GWh

   By its nature, meter error does not apply to SSP sites, and so this value of UG is all attributed to the LSP sector.

8. The sum of the directly measured UG components calculated in #5-#7 above is listed in the tables in Section 7 as "Total Directly Measured". The SSP and LSP elements are summed and deducted from the total LSP assigned UG figure (calculated in #3 above) to give the total for the Balancing Factor. At this stage the Balancing Factor is a single figure, the sum of SSP and LSP elements.

9. All elements of the Balancing Factor other than Theft are either small or will sum to zero over time. Therefore it is reasonable to split the Balancing Factor volume between the SSP and LSP market sectors using the percentage split for Theft, as defined in Section 6.6 above.

SSP proportion = 92.1%
LSP proportion = 7.9%

For EA LDZ for a single year:

RbD Bias = 1166.0 GWh
Algorithm Bias = 209.7 GWh
LSP Assigned Unidentified Gas = 956.3 GWh
Directly Measured UG = 207.7 GWh
Aggregate Balancing Factor = 748.6 GWh

SSP Balancing Factor = 748.6 * 0.921 = 689.4 GWh
LSP Balancing Factor = 748.6 * 0.079 = 59.1 GWh

10. Finally, total UG from each sector is calculated by summing the components, values for all of which have now been populated:

    SSP UG = 56.4 GWh + 11.9 GWh + 689.4 GWh = 757.7 GWh
    LSP UG = 3.0 GWh + 134.7 GWh + 1.75 GWh + 59.1 GWh = 198.6 GWh

These calculations are then repeated for each LDZ.

7 Unidentified Gas Estimates

This section contains the current best estimates of Unidentified Gas calculated using the methods described in Section 6 above (using data received as at 26th September 2011). Estimates are presented on an LDZ and LDZ basis, with each LDZ's figures split into SSP and LSP market sectors, and also by each category of Unidentified Gas. The Scottish Independents are also included, although their contribution to the overall UG figure is negligible. These figures therefore give a full breakdown of Unidentified Gas by source in each LDZ.

Tables 6-12 show this full breakdown for each LDZ, whilst Table 13 shows summary information only. This includes the Unidentified Gas totals. The most important figure from this table is the total LSP Unidentified Gas figure, which represents the aggregate volume of gas to be moved from the SSP to the LSP sector. The current best estimate of this figure is 2.0TWh per annum, a figure that represents approximately 20% of RbD.

Full details are shown in the tables below, and commentary on the figures is provided below this. Tables 6-12 are in two parts. The top section in each table shows the breakdown of Unidentified Gas by category, with different columns for the SSP and LSP market sectors. The individual components of the Shipperless/Unregistered category are shown in grey, with the total for the category in black. The LDZ Unidentified Gas totals for the SSP and LSP sectors are in the bottom line of the top section of the table, shown in bold. The lower section of the table shows four LDZ-wide figures (i.e. covering both SSP and LSP sectors) that are used in the calculation of the market sector-specific values in the top section. These are RbD bias, allocation algorithm bias, LSP Assigned Unidentified Gas Total (SSP + LSP) and Aggregate Theft + Other (i.e. the Balancing Factor). All units are GWh.

TABLE 6: UNIDENTIFIED GAS SUMMARY (GWh) – EA, EM AND NE

	EA		EM		NE	
	SSP	LSP	SSP	LSP	SSP	LSP
iGT CSEPs	56.38	3.00	163.45	5.64	15.41	0.65
Shipperless/Unregistered	11.87	134.73	13.56	98.75	8.82	53.04
- Shipper Activity	0.08	1.14	0.11	0.21	0.08	0.12
- Orphaned	3.23	41.30	2.87	35.70	1.79	18.21
- Unregistered <12 Months	3.03	41.75	4.05	50.80	3.58	22.25
- Shipperless PTS	1.31	0.96	1.37	0.72	0.42	0.78
- Shipperless SSrP	4.22	49.57	5.15	11.32	2.94	11.68
- Shipperless <12 Months	0.00	0.00	0.00	0.00	0.00	0.00
Meter Errors	0.00	1.75	0.00	2.49	0.00	1.47
Total Directly Measured	68.25	139.47	177.01	106.87	24.23	55.16
Theft + Other	689.44	59.14	377.34	32.37	378.69	32.48
Total	**757.69**	**198.61**	**554.35**	**139.24**	**402.92**	**87.64**

RbD Bias	1166.0	1039.8	712.2
Algorithm Bias	209.7	346.2	221.6
Unidentified Gas (LSP Assigned)	956.3	693.6	490.6
Aggregate Theft + Other	748.6	409.7	411.2

TABLE 7: UNIDENTIFIED GAS SUMMARY (GWh) – NO, NT AND NW

	NO		NT		NW	
	SSP	LSP	SSP	LSP	SSP	LSP
iGT CSEPs	32.42	2.84	48.16	9.46	59.59	9.48
Shipperless/Unregistered	5.72	65.77	21.64	123.06	16.37	514.22
- Shipper Activity	0.05	0.03	0.21	0.77	0.10	0.60
- Orphaned	1.60	32.78	6.44	37.77	4.52	63.15
- Unregistered <12 Months	2.17	29.45	4.04	71.97	5.10	431.33
- Shipperless PTS	0.57	0.63	2.55	3.18	1.46	1.46
- Shipperless SSrP	1.33	2.88	8.39	9.38	5.19	17.69
- Shipperless <12 Months	0.00	0.00	0.00	0.00	0.00	0.00
Meter Errors	0.00	-4.04	0.00	2.49	0.00	2.71
Total Directly Measured	38.14	64.58	69.80	135.02	75.96	526.41
Theft + Other	329.62	28.27	58.38	5.01	193.18	16.57
Total	**367.76**	**92.85**	**128.18**	**140.03**	**269.14**	**542.98**

RbD Bias	610.4	466.3	1259.2
Algorithm Bias	149.8	198.1	447.1
Unidentified Gas (LSP Assigned)	460.6	268.2	812.1
Aggregate Theft + Other	357.9	63.4	209.8

TABLE 8: UNIDENTIFIED GAS SUMMARY (GWh) – SC, SE AND SO

	SC		SE		SO	
	SSP	LSP	SSP	LSP	SSP	LSP
iGT CSEPs	110.36	5.59	26.81	4.52	23.64	1.57
Shipperless/Unregistered	14.25	177.04	34.26	110.22	11.81	126.16
- Shipper Activity	0.21	0.55	0.22	0.91	0.15	0.39
- Orphaned	3.04	31.77	4.54	30.12	1.63	19.09
- Unregistered <12 Months	5.37	101.31	8.89	30.31	3.79	51.30
- Shipperless PTS	2.50	4.44	3.01	4.24	1.33	2.24
- Shipperless SSrP	3.12	38.97	17.60	44.63	4.92	53.14
- Shipperless <12 Months	0.00	0.00	0.00	0.00	0.00	0.00
Meter Errors	0.00	1.92	0.00	2.39	0.00	1.50
Total Directly Measured	124.61	184.55	61.08	117.12	35.45	129.23
Theft + Other	45.04	3.86	397.61	34.11	299.19	25.66
Total	**169.66**	**188.41**	**458.69**	**151.23**	**334.64**	**154.90**

RbD Bias	706.8	974.1	675.8
Algorithm Bias	348.8	364.1	186.2
Unidentified Gas (LSP Assigned)	358.1	609.9	489.5
Aggregate Theft + Other	48.9	431.7	324.9

TABLE 9: UNIDENTIFIED GAS SUMMARY (GWh) – SW, WM AND WN

	SW		WM		WN	
	SSP	LSP	SSP	LSP	SSP	LSP
iGT CSEPs	69.13	1.00	57.62	2.96	6.41	0.16
Shipperless/Unregistered	9.68	88.09	10.32	71.71	2.42	2.70
- Shipper Activity	0.13	0.68	0.08	0.27	0.07	0.00
- Orphaned	2.24	24.25	2.41	23.01	0.25	1.43
- Unregistered <12 Months	5.31	54.01	3.35	43.54	0.92	1.25
- Shipperless PTS	0.66	0.98	0.80	0.90	0.67	0.02
- Shipperless SSrP	1.33	8.18	3.67	4.00	0.51	0.00
- Shipperless <12 Months	0.00	0.00	0.00	0.00	0.00	0.00
Meter Errors	0.00	1.63	0.00	2.22	0.00	0.22
Total Directly Measured	78.81	90.73	67.94	76.89	8.82	3.08
Theft + Other	236.34	20.27	470.57	40.36	29.06	2.49
Total	**315.15**	**111.00**	**538.51**	**117.25**	**37.88**	**5.57**

RbD Bias	598.2	1149.4	84.6
Algorithm Bias	172.1	493.6	41.2
Unidentified Gas (LSP Assigned)	426.1	655.8	43.5
Aggregate Theft + Other	256.6	510.9	31.6

TABLE 10: UNIDENTIFIED GAS SUMMARY (GWh) – WS

	WS	
	SSP	LSP
iGT CSEPs	23.87	1.22
Shipperless/Unregistered	4.71	47.99
- Shipper Activity	0.02	0.22
- Orphaned	0.85	14.30
- Unregistered <12 Months	1.28	28.15
- Shipperless PTS	0.67	3.72
- Shipperless SSrP	1.89	1.60
- Shipperless <12 Months	0.00	0.00
Meter Errors	0.00	0.59
Total Directly Measured	28.58	49.80
Theft + Other	289.32	24.82
Total	**317.90**	**74.61**

RbD Bias	419.6
Algorithm Bias	27.0
Unidentified Gas (LSP Assigned)	392.5
Aggregate Theft + Other	314.1

TABLE 11: UNIDENTIFIED GAS SUMMARY (GWh) – LC, LO AND LS

	LC		LO		LS	
	SSP	LSP	SSP	LSP	SSP	LSP
iGT CSEPs	0.00	0.00	0.00	0.00	0.00	0.00
Shipperless/Unregistered	0.02	0.00	0.03	0.31	0.18	0.11
- Shipper Activity	0.00	0.00	0.00	0.00	0.00	0.01
- Orphaned	0.01	0.00	0.01	0.00	0.01	0.00
- Unregistered <12 Months	0.00	0.00	0.01	0.00	0.17	0.00
- Shipperless PTS	0.00	0.00	0.00	0.31	0.00	0.00
- Shipperless SSrP	0.00	0.00	0.01	0.00	0.00	0.09
- Shipperless <12 Months	0.00	0.00	0.00	0.00	0.00	0.00
Meter Errors	0.00	0.00	0.00	0.00	0.00	0.00
Total Directly Measured	0.02	0.00	0.03	0.31	0.18	0.11
Theft + Other	-0.01	0.00	1.98	0.17	0.11	0.01
Total	**0.00**	**0.00**	**2.00**	**0.48**	**0.29**	**0.12**

RbD Bias	-0.9	3.0	0.0
Algorithm Bias	-0.7	0.5	-0.4
Unidentified Gas (LSP Assigned)	0.0	2.5	0.4
Aggregate Theft + Other	0.0	2.1	0.1

TABLE 12: UNIDENTIFIED GAS SUMMARY (GWh) – LT AND LW

	LT		LW	
	SSP	LSP	SSP	LSP
iGT CSEPs	0.00	0.00	0.00	0.00
Shipperless/Unregistered	0.00	0.00	0.00	0.00
- Shipper Activity	0.00	0.00	0.00	0.00
- Orphaned	0.00	0.00	0.00	0.00
- Unregistered <12 Months	0.00	0.00	0.00	0.00
- Shipperless PTS	0.00	0.00	0.00	0.00
- Shipperless SSrP	0.00	0.00	0.00	0.00
- Shipperless <12 Months	0.00	0.00	0.00	0.00
Meter Errors	0.00	0.00	0.00	0.00
Total Directly Measured	0.00	0.00	0.00	0.00
Theft + Other	0.56	0.05	1.17	0.10
Total	**0.56**	**0.05**	**1.17**	**0.10**

RbD Bias	0.8	1.8
Algorithm Bias	0.2	0.5
Unidentified Gas (LSP Assigned)	0.6	1.3
Aggregate Theft + Other	0.6	1.3

TABLE 13: UNIDENTIFIED GAS SUMMARY (GWh)

LDZ	SSP	LSP	Total
EA	757.7	198.6	956.3
EM	554.4	139.2	693.6
NE	402.9	87.6	490.6
NO	367.8	92.8	460.6
NT	128.2	140.0	268.2
NW	269.1	543.0	812.1
SC	169.7	188.4	358.1
SE	458.7	151.2	609.9
SO	334.6	154.9	489.5
SW	315.1	111.0	426.1
WM	538.5	117.2	655.8
WN	37.9	5.6	43.5
WS	317.9	74.6	392.5
LC	0.0	0.0	0.0
LO	2.0	0.5	2.5
LS	0.3	0.1	0.4
LT	0.5	0.1	0.6
LW	1.2	0.1	1.3
Total	**4656.5**	**2004.9**	**6661.6**

The following points of interest arise from these tables:

- The “Shipperless <12 Months” category is currently populated with zeros due to data not yet having been supplied for this type of site. Unidentified Gas from this source is currently collected in the Balancing Factor and so when it is populated this will not affect the overall UG total. It may have a small effect on the split between SSP and LSP Unidentified Gas, however.
- Given the nature of the calculation, the lack of Shipperless <12 Months data means that values of the Balancing Factor are also only interim figures at this point. Again, this will not affect the final UG totals.
- Figures for WN are much lower than those for other LDZs. This is consistent with the very low RbD bias observed in this LDZ.
- The high level of LSP Unidentified Gas observed in NW LDZ is mostly due to the “Unregistered <12 Months” category. The raw Unregistered and Shipperless Sites Report shows a consistent and very high AQ of sites in this category.
- The contribution of Meter Error is negative in NO LDZ, indicating that in this LDZ there is a net over-read from the LSP sector rather than an under-read.
- The other factors grouped with Theft in the Balancing Factor (Shrinkage and common-cause variation) can reasonably be assumed to vary around zero and hence sum to zero over time. Therefore the aggregate value of the Balancing Factor across all LDZs can be taken as a good indicator of the level of Theft indicated by this analysis. Total Theft (SSP plus LSP) is estimated at 4119GWh per annum, which is 0.66% of throughput.
- In NT and SC LDZs, the value of the Balancing Factor is low. This does not indicate that Theft is unusually low in these LDZs, but just that the other factors grouped with Theft are taking relatively high and opposite values in these instances. In other cases the Balancing Factor is high, indicating the opposite effect. It is theoretically possible for the Balancing factor to be negative if the additional factors are large enough and act in the opposite direction to Theft. Such an effect has not been observed at any point during the analysis, however.

8 Consultation Questions and Answers

This section captures the questions raised by the Industry Bodies during the consultation periods and the AUGE responses. The questions have been assessed against the AUGE Guidelines [1] and responses provided as appropriate. All questions and answers have also been published on the Joint Office website.

Due to the in-depth nature of the questions raised and the detailed responses required, it is not appropriate to publish full transcripts in this document. Instead, this section contains a summary of the organisations that provided questions. The questions themselves and their associated responses can be found in external document "AUGS Query Responses 30_09_2011" [23].

Note that all responses contained in this document relate to the Unidentified Gas calculations at the time they were written, rather than reflecting the process as it currently stands. Therefore, wherever information differs between the responses and the latest AUGS, this is because the Unidentified Gas analysis has evolved and information in the response documents has been superseded. The information supplied in the latest version of the AUGS is always the most up-to-date.

Table 14 below contains a list of organisations that responded to the first draft of the AUGS.

TABLE 14: RESPONSES TO THE FIRST DRAFT OF THE AUGS

Organisation Name	Date of Communication
National Grid Transmission	06/05/2011
Corona Energy	23/05/2011
E.On	23/05/2011
Centrica	15/06/2011
EDF Energy	16/06/2011
GDF Suez	16/06/2011
Gazprom	17/06/2011
Scottish Power	17/06/2011

9 Contact Details

Questions can be raised with the AUGE at AUGE@gl-group.com

10 References

[1] Guidelines for the Appointment of an Allocation of Unidentified Gas Expert and the provision of the Allocation of Unidentified Gas Statement V3.0, 24th February 2011

[2] Mod 369 Re-establishment of Supply Meter Points – measure to address shipperless sites

[3] Mod 194 Framework for correct apportionment of NDM error

[4] Mod 194a Framework for correct apportionment of LSP unidentified gas

[5] Mod 228/228A Correct apportionment of NDM Error – Energy

[6] UNC Modification Proposals 228 and 228A Correct Apportionment of NDM Error – Energy. An Assessment by TPA Solutions Ltd, January 2010

[7] Mod 229 Mechanism for Correct Apportionment of Unidentified Gas implemented in UNC Section E 10 v3.54 26th April 2011,

[8] Theft of Electricity and Gas “Next Steps”, OFGEM, January 2005

[9] Reducing Supplier Disincentives to Detect and Investigate Gas Theft – Uniform Network Code Proposal UNC231V and other Changes, OFGEM, December 2010

[10] Mod 0274 Creation of a National Revenue Protection Service, Version 1.0, 11th November 2009, Eon

[11] Mod 277 Modification Report “Creation of Incentives for the Detection of Theft of Gas (Supplier Energy Theft Scheme)” Version 2.0, 20th January 2011, Joint Office of Gas Transporters

[12] Mod 346 An Alternative to the Supplier Energy Theft Scheme Based on Throughput Version 2.0, 20th January 2011, Centrica

[13] Theft of Gas Info Pack, Xoserve, March 2011

[14] Uniform Network Code (UNC) 194, 194A, 228, 228A and 229: These proposals deal with the identification and apportionment of costs of Unidentified Gas, OFGEM, 26th May 2010

[15] Uniform Network Code (UNC) Transportation Principal Document

[16] National Leakage Tests, GL Noble Denton, 2003

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[18] Theft of Electricity and Gas, Discussion Document, OFGEM, April 2004

[19] Mod 254 Facilitating the use of forecast data in the UNC section H 1.5

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[21] Mod 209 Rolling AQ

[22] Evaluation of algorithm performance – 2009/10 gas year, February 2011, Xoserve

[23] AUGS Query Responses

[24] “Review of Reconciliation by Difference (RbD) Xoserve response to Consultation Ref: 57/06”, 11 May 2006

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[26] LDZ Shrinkage Quantity Final Estimates Formula Year 2011/12, V1.1, 1st March 2011, Wales and West Utilities.

[27] Final LDZ Shrinkage Proposal for Formula Year 2011/12, 1st March 2011, National Grid

[28] Final LDZ Shrinkage Proposals for Formula Year 2011/12, 1st March 2011, Scotia Gas Networks

[29] Final Proposals of LDZ Shrinkage Quantity North East and Northern LDZ Formula Year 2011/12, 1st March 2011, Northern Gas Networks

[30] LDZ Shrinkage Quantity Initial Proposals Formula Year 2011/12, National Grid, 1st January 2011

[31] Statistical verification of the 2002/3 National Leakage Test programme, Industrial Research Unit 2003

[32] Test Site Audit Report No 414/OA, Haswell Consulting Engineers, 30 May 2003

[33] Independent Review of Service Leakage Estimation Methodology, GL Noble Denton, 2009

[34] Above Ground Installation Shrinkage – Final Report 2003, Advantica (now GL Noble Denton)

[35] Statistical Verification of 2003 Above Ground Installation Leakage Tests, Industrial Statistics Research Unit, August 2003

[36] Principle and operation of the Advantica Fugitive Measurement Device. Nottingham University Consultants Limited, July 2003

[37] Own Use Gas Model for Pre-heaters, Advantica (now GL Noble Denton), May 2002

[38] Summary of Pre-heater trial reports, Advantica (now GL Noble Denton), 2006

[39] UNC Section E 7.4, "Annual Quantity revision and End of Year AQ Reconciliation", v3.54 26th April 2011

[40] The Customer Discovery Event 2011 – Annual Quantities, Xoserve 2011

[41] Correct Apportionment of Unallocated Gas Volumes and Mod 228, CEPA LLP

Glossary

AGI	Above Ground Installation
AQ	Annual Quantity
AUGE	Allocation of Unidentified Gas Expert
AUGS	Allocation of Unidentified Gas Statement
Balancing Factor	An aggregate of the combined unidentified gas of various items calculated by subtraction. This includes theft, errors in the Shrinkage estimate, open bypass valves, meters “Passing Unregistered Gas”, unknown sites, and additional Common Cause variation.
CSEP	Connected System Exit Point
CV	Calorific Value
DM	Daily Metered
ECV	Emergency Control Valve
EUC	End User Category
IGT	Independent Gas Transporter
LSP	Larger Supply Point
MAM	Meter Asset Manager
MEG	Monoethylene Glycol
Model Error	The statistical error associated with any modelling or estimation process. It an inherent part of any statistical model and does not imply that the model itself is inadequate or incorrect.
MPRN	Meter Point Reference Number
NDM	Non Daily Metered
OUG	Own Use Gas
RbD	Reconciliation by Difference
SND	Seasonal Normal Demand
SSP	Smaller Supply Point
TPD	Transportation Principle Document
UIP	Utility Infrastructure Provider
UNC	Uniform Network Code
UG	Unidentified Gas