DNV·GL

ALLOCATION OF UNIDENTIFED GAS

2014 Proposed Allocation of Unidentified Gas Statement for 2015/16

Xoserve Ltd

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Task and objective:

Develop and document the methodology to estimate unidentified gas volumes and apportion these between the LSP and SSP market sectors

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Reference to part of this report which may lead to misinterpretation is not permissible.

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1	1st May 2014	First issue	Tony Perchard Andy Gordon Mark Lingham	Clive Whitehand	Anthony Gilbert
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EXECUTIVE SUMMARY

This document contains details of the methods developed by the Allocation of Unidentified Gas Expert (AUGE) for estimating the overall level of Unidentified Gas (UG) and allocating it between market sectors, the data requested to support this analysis, and the data received following such requests. Full estimates of the total energy value of UG split by LDZ and source will be provided once the methodology described in this document has been approved by the Uniform Network Code Committee (UNCC).

In addition to the above, this document describes how the AUGE has followed the published guidelines.

This document is the proposed (2nd Draft) 2014 AUGS for 2015/16. The document describes analyses undertaken in 2014 to improve the estimate of UG by accounting for the impact of various UNC modifications. The following key areas have been covered:

- UNC Modification 0410A
- UNC Modification 0425V
- UNC Modifications 0398 and 0429
- UNC Modification 0431
- UNC Modification 0469S
- Impact of Changes to Supplier Licences to Increase Theft Detection Rates
- Update to CSEP consumption methodology

Section 3 of this document provides a high level overview of the methodology in general terms. This section has been updated to improve the clarity of the methodology description. A section has also been added to cover the issue of materiality.

Section 3.4 describes the analyses carried out this year and conclusions reached. It does not describe the resulting methodology as this is covered separately.

From the analyses undertaken in the preparation of this AUGS we have concluded the following:

- The effects of Mod 0410A on Unregistered sites can be modelled using new information now supplied by Xoserve in the two-monthly snapshot files. Sites where the MPRN was created before 01/09/2013 (and hence are not subject to Mod 0410A) and those where the MPRN was created on or after 01/09/2013 (and hence are subject to Mod 0410A) must be modelled separately. At the time of writing insufficient data exists to extrapolate the effects of the modification to the forecast year with any accuracy, and therefore a number of options have been developed that cover the possible scenarios. The calculation of the final UG figures for 2015/16 will use the appropriate option based on the data available at the time the analysis is carried out.
- Mod 0425 affects Shipperless SSrP sites in the same manner that Mod 0424 affects Shipperless PTS sites, and can be modelled using the same techniques. Therefore the effects of this modification will be modelled and included in the UG figures for 2015/16.
- The impact of Mod 0398 is expected to be small, and the implementation of Mod 0429 will further reduce its impact by allowing claims for large errors outside the reconciliation window. The effects of Mod 0429 can be incorporated into the current UG calculations with very little

change to the process. If there are any claims under Mod 0429, these will be incorporated into the calculations and the final UG figures for 2015/16.

- Mod 0431 has the potential to impact on both Shipperless UG and the estimate of total UG from the consumption method. The magnitude of any such impact will be unknown until Xoserve's portfolio reconciliation analysis has been carried out, however. Xoserve have agreed to supply data to the AUGE that will allow any effect of Mod 0431 to be incorporated into calculations on completion of their analysis.
- Mod 0469 is currently being evaluated by the industry and hence no action will be taken relating to it at this time.
- The effects of Ofgem's change to Supplier licences to increase theft detection rates are likely to be of a small magnitude in the short term. The AUGE's current methods will naturally account for any changes that do occur within the dataset provided for the calculation of the final UG figures, and no adjustment is required for further potential changes in theft detection rates beyond this.
- Following a query from British Gas, the CSEP consumption calculation methodology has been revised. The new approach aims to reduce any bias resulting from using AQ values based on either default values from the NExA table or rolled over AQs where recalculation has not been successful. The new approach also takes into account the part year consumption from new/lost meters.

Section 5 describes the data used and the status of all current data requests that have been made.

Section 6 describes the resulting methodology proposed for April 2015 – March 2016.

Section 7 gives the format of the Unidentified Gas output tables.

Section 8 references consultation feedback and responses from previous statements.

TABLE OF CONTENTS

List of Figures

List of Tables

1 INTRODUCTION

1.1 Background

The Great Britain gas industry is 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 73,201 kWh and above, Smaller Supply Points have an AQ of up to 73,200 kWh. Many processes within the gas industry differ between these two sectors.

The majority of gas consumed in Great Britain 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. Some elements of the gas that is not directly consumed/measured are currently modelled, and hence the gas consumed by these can be estimated. The gas that is lost and not recorded or modelled is referred to as Unidentified Gas (UG).

Prior to April 2012 there was no methodology in place to determine the allocation of UG between the LSP and SSP market sectors: UG was allocated entirely to the SSP market sector (an interim amount was allocated for 2011/12). Through the approval of Modification 229 (implemented in UNC section E 10 – Mechanism for Correct Apportionment of Unidentified Gas [5]) and the appointment of an Allocation of Unidentified Gas Expert (AUGE), a methodology has been defined to ensure that UG can be estimated 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 (via the combination of Commodity, Energy Balancing and Reconciliation invoicing) is determined by the volume of gas transported as measured by the metering equipment. For SSPs, the commodity charge is ultimately derived (via NDM Allocation and Reconciliation by Difference) by calculating the difference between the volumes of gas measured coming in to the network and the volume of gas measured by the LSPs. Each Shipper with a 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. This calculation of SSP load by subtraction leads to all lost gas being assigned to this market sector.

There have been several UNC modification proposals intended to resolve this issue (Mod 0194 [2], 0194a [3], 0228 [4], 0228a [4]), none of which were accepted by the industry. A further modification, Mod 0229 [5] provided for the appointment of an AUGE with responsibility for determining the value of UG so that relevant quantities could be allocated to the correct market sectors.

DNV GL (formerly GL Noble Denton) was appointed to the role of AUGE in 2011 and has developed a methodology to estimate UG and to apportion it fairly across both the LSP and SSP market sectors.

The first draft methodology (used to produce the figures presented in the 2011 AUGS for 2012/13 [10]) used RbD and AQ Bias to estimate total UG. Items of UG that could be estimated and apportioned directly were deducted to leave a Balancing Factor that was split into market sectors using the SSP/LSP split of detected theft as a basis. Figures in the AUG table were composed of directly estimated UG (e.g. Shipperless, Unregistered sites etc.) plus the relevant portion of the Balancing Factor for that market sector.

In 2012, consumption data was requested for all customers with the aim of developing a more accurate estimate of UG. Data was provided for all customers where meter reads/consumptions have been provided to Xoserve (excluding CSEPS which use AQ information) and used to estimate total UG by subtracting the total consumption from the gas input. A methodology was produced and

documented based on this data but timescales prevented it being implemented for the 2012 AUG process.

The consumption methodology was therefore first used in 2013 to estimate UG for 2014/15. This version included improvements to key areas following the consultation on the previous 2nd Draft 2012 AUGS for 2013/14 [19] and the 1st Draft 2013 AUGS for 2014/15 [25]. This document describes the analysis undertaken in 2014 and the proposed UG calculation methodology for 2015/16, which includes further improvements based on the latest data and UNC modifications.

1.2 High Level Objectives

The AUGE's high level objectives are:

- To determine what data is required from industry bodies to evaluate UG
- To develop and update the methodology for calculating UG
- 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 UG totals and rates

1.3 Scope

This document contains the following:

- A detailed description of the proposed methodology
- Description of areas of the methodology that are being developed further and the proposed approach to these as appropriate
- Summary of data requested, received and used, and associated assumptions
- A list of questions raised by the industry bodies during consultations (full details of the questions and responses are provided in separate documents)
- Details of the database used to hold information associated with UG and used to develop the methodology
- Details of the analyses carried out in 2014 in preparation of the methodology

The final AUGS Table and financial estimates will be supplied to the industry once the methodology has been approved.

1.4 Out of Scope

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

The AUGE is not concerned with resolution of fundamental gas industry business process issues.

The AUGE process is not an opportunity to deal with/investigate issues within the gas industry that should be addressed by other workgroups (e.g. Shrinkage Forum).

The AUGE is not concerned with transportation charges associated with UG.

1.5 Document Status

This section provides a status summary of the Unidentified Gas methodology as contained in this version of the AUGS. Final estimates of the energy value and financial value of UG have not been made at this stage, and will only be provided when the methods detailed in this AUGS have been approved by the UNCC. Table 1 shows the status of each element of UG.

Table 1: Unidentified Gas Estimate Status

Unidentified Gas Subject	**Data Status**	**Methodology Status**	**AUGS Status**
Unregistered sites	Updated data provided every two months	Updated method proposed for consultation due to implementation of Mod 0410A [20]	Methodology updated and described in full in this document
Shipperless sites	Updated data provided every two months	Updated method proposed for consultation due to implementation of Mods 0424 [15] and 0425 [16]	Methodology updated and described in full in this document
IGT CSEPs	Updated data provided every two months	Complete	Methodology described in 2013 AUGS for 2014/15 [29] and included in this document for completeness
Shrinkage error	N/A	Complete	Status described in 2011 AUGS [10]
Shipper responsible theft	Theft data covering detections to end 2012 received. Updated data to end March 2014 pending.	Complete	Updated analysis described in this document but propose no changes to the methodology Methodology is described in full for completeness

Unidentified Gas Subject	Data Status	Methodology Status	AUGS Status
Metering errors (SSP supply point, NDM LSP Supply point, DM supply point, LDZ offtake metering)	Updated data pending	Complete	Methodology described in 2013 AUGS for 2014/15 [29] and included in this document for completeness
Overall UG estimate: using meter reads / metered volumes	Updated data pending	Complete	Methodology described in 2013 AUGS for 2014/15 [29] and included in this document for completeness

2 COMPLIANCE TO GENERIC TERMS OF REFERENCE

This section describes how DNV GL 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 developed a detailed methodology for estimating total UG using meter read and consumption data for both LSP and SSP sectors, and has requested from Xoserve the necessary data to apply this method. Further detailed datasets are used to directly estimate some components of the total UG where this is possible e.g. Shipperless sites. The AUGE has also developed a methodology to account for elements of UG which are temporary in nature.

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 UG has been decided solely by the AUGE based on information supplied by all parties. Comments raised by shippers relating to the AUGS documents from previous years have been considered and responses issued, as detailed in Section 8 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 proposed methodology and has requested information from relevant parties. For the 2015/16 analysis, updated data sets have been requested from Xoserve for all items.

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 what data is available following discussions with Xoserve, as all of the data required for this analysis is held by them.

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 gas.

Questions regarding various elements of UG have been sent to Shippers during the production of the AUGS for previous years. Further communication will take place as and when necessary.

The AUGE will use the latest data available where appropriate.

Data for the 2014 method has been requested. This includes updates to LSP consumptions (including corrections from 2008 onwards) and new meter reads for SSPs up to the end of March 2014. Updates for theft data, CSEPs, Shipperless/Unregistered sites etc. have also been requested and will be used to generate the interim AUG table later in the year. Xoserve have set up several processes for producing reports containing new data on a regular basis (for example the two-monthly Shipperless/Unregistered site snapshots). These will continue to be supplied to the AUGE to ensure that the latest data is used for each analysis as appropriate.

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.

For the consumption method of estimating total UG, both meter reads and metered volumes are provided. Over time LSP metered volumes may be corrected, but the meter reads are not. Xoserve advised the AUGE to use metered volumes but analysis has shown that these can be erroneous, particularly for non-corrected SSP data. Therefore the decision was taken to use meter reads for SSP and metered volumes for LSP. Details of how these are determined are described in previous versions of the AUGS [18], [29].

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

Throughout the statement the AUGE has described how data will be used and why.

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.

The consumption method for estimating the UG total is the only part of the analysis where a sample rather than the full dataset is used. This calculation will be at its most accurate when the largest possible representative subset of the meter point population is used. In order to achieve this, a validation process was developed that was designed to maximise the sample size whilst removing any meter points with invalid data. This is described fully in the 2013 AUGS for 2014/15 [29].

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 AUGS from previous years. Section 8 of this document refers to these publications with details of the issues raised, with the full text of the comments from the Code Parties and the AUGE responses contained in separate documents published on the Joint Office of Transporters website.

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 of the methodology used.

Responses have been issued to all parties who submitted comments on any draft or final version of the AUGS from previous years, and these are noted in Section 8. Separate documents provide the detail of all responses [8], [9], [11], [12], [13], [19], [25], [30], [31], [32], [37].

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.

All queries have been carefully considered by the AUGE and where appropriate improvements to the UG calculation have been made. The evolution of the UG calculation can be seen in successive versions of the AUGS.

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

This 2nd draft 2014 AUGS for 2015/16 is provided to the Gas Transporters for publication on 1st August 2014.

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 stores the data in a secure project storage area with limited access by the consultants working on the project. The AUGE can confirm data used in the analysis has not and will not be passed on to any other organisation. The data used will be made available to all bona fide industry participants in order to review the methodology, and in this dataset all MPR information has been replaced by 'dummy' MPR references by Xoserve so that the anonymity of the consumer is protected.

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

3 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 is given in Section 6 and in previous versions of the AUGS [10], [18], [29].

3.1 LDZ Load Components

Daily load (as measured or calculated at the Supply Meter Point) falls into three relevant categories as far as the reconciliation process is concerned. These are as defined in section A4.3.2 of the Uniform Network Code (UNC) [6]:

1. Smaller Supply Point Component Load

Load from Supply Point Components (SPCs) which are part of a Smaller Supply Point (SSP).

2. Larger Non Daily Metered Supply Point Component Load

Load from Non Daily Metered (NDM) SPCs which are part of a Larger Supply Point (LSP). Note that Large NDM SPCs may contain individual meters that fall below the SSP AQ threshold of 73,200 kWh.

3. Daily Metered Supply Point Component (DM SPC) Load

Load from Daily Metered (DM) SPCs which are part of a LSP. This includes DMM sites (i.e. mandatory DM sites which are above the 58,600,000 kWh threshold), DMV (Daily Metered Voluntary) and DME (Daily Metered Elective) sites.

DM load is by definition metered and known on an ongoing daily basis. However, it is subject to metering error and data for known errors is used to correct it. NDM load for a given day can be estimated from available meter reads (and corrections) using a method based on the NDM deeming algorithm (Section H [6]).

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

1. 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 UNC [6].

2. Unidentified Gas

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

- Unregistered and Shipperless sites
- Independent Gas Transporter Connected System Exit Point (IGT CSEP) setup and registration delays
- Errors in the Shrinkage estimate

- Shipper-responsible theft
- Meter errors – this includes LDZ offtakes, LSP consumer meters and SSP consumer meters

UG is currently unknown and hence must be estimated.

The relationship between these components of daily load can therefore be expressed as follows:

$$Total\ UG = Aggregate\ LDZ\ Load - DM\ Load - Shrinkage - NDM\ Load \quad (3.1)$$

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 UG 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.

3.2 Permanent and Temporary Unidentified Gas

Unidentified gas can be divided into two categories:

Permanent UG is consumed in an unrecorded fashion and costs are never recovered.

Temporary UG is initially consumed in an unrecorded fashion, but volumes are later calculated directly or estimated and the cost is recovered via backbilling.

As the costs for temporary UG will ultimately be directly recovered it is only necessary to include permanent UG in the final published figures. It is nevertheless necessary to calculate the temporary element in each case in order for it to be deducted from the calculated total UG and leave only the permanent element.

Table 2 below shows the permanent/temporary status of each element of UG.

Table 2: Permanent and Temporary UG

Unidentified Gas Source	**Type**
iGT CSEPs	*Temporary* for LSP sites on CSEPs. *Permanent* for SSP sites on CSEPs.
Shipperless/Unregistered	
• Shipper Activity	*Temporary* if shipper carries out site works. *Temporary* if a third party carries out site works but read supplied with meter fix details is the same as the shipper's opening meter read. *Permanent* otherwise.
• Orphaned	As for "Shipper Activity".
• Unregistered <12 Months	As for "Shipper Activity".
• Shipperless PTS	*Permanent* for sites that were Isolated prior to 01/04/2013. *Temporary* otherwise.

Unidentified Gas Source	Type
• Shipperless SSrP • Without Shipper <12 Months	*Permanent* for sites that were Isolated prior to 01/04/2014. *Temporary* otherwise. *Permanent* if the site would be classified as PTS once its GSR visit has taken place and it was Isolated before 01/04/2013. *Permanent* if the site would be classified as SSrP once its GSR visit has taken place and it was Isolated before 01/04/2014, or if there is no record of when the new meter was installed. *Temporary* otherwise.
Meter Errors	*Temporary* for detected errors that are corrected within the reconciliation period or via the Mod0429 claims process. *Permanent* otherwise.
Theft	*Temporary* for detected theft. *Permanent* for other theft.

3.3 Unidentified Gas Methodology

The proposed method for estimating total UG for the year 2015/16 is based on the consumption-based approach first described in the 2nd draft 2012 AUGS for 2013/14 [18]. The methodology is essentially the same as that described in the final 2013 AUGS for 2014/15 [29] with some updates discussed in section 4 and incorporated into the methodology as described in Section 6. Most of these updates relate to modifications which have been implemented since the previous AUGS and require a change to the methodology to correctly apportion UG.

3.3.1 Estimation of Total UG for Historic Years

The overall concept of calculating total UG using metered consumption data is simple, and is centred on the basic principle of the allocation process. The NDM Allocation is calculated as follows:

NDM Allocation = Aggregate LDZ Load – DM Load – Shrinkage

This is shown graphically in Figure 1.

As the NDM load in equation 3.1 is the sum of all metered NDM consumptions, this allows us to rewrite (3.1) as

Total UG = NDM Allocation – Metered NDM Consumption (3.2)

This is based on the assumption that there is no significant permanent UG arising from errors in Aggregate LDZ Load, DM Load or Shrinkage.

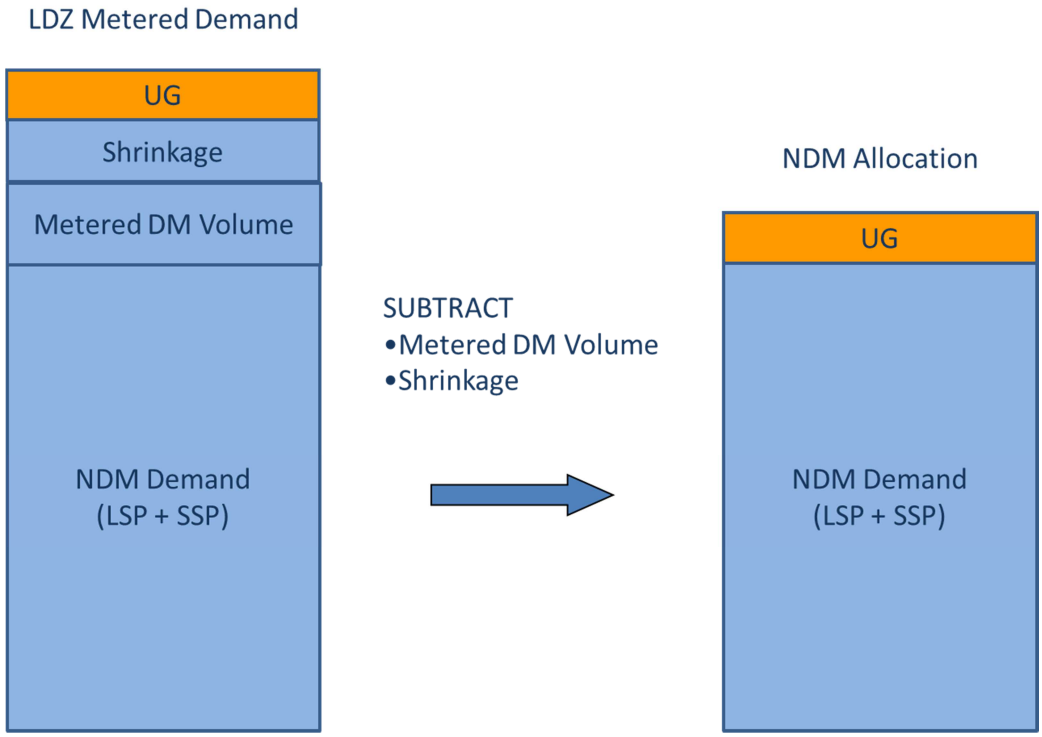

Figure 1: NDM Allocation and Unidentified Gas

The metered NDM consumption is calculated for each meter point and formula year using meter reads or metered volumes, and meter asset information. There are a number of complexities in this calculation that must be accounted for in the methodology and a fall-back approach must be developed for those meter points without sufficient data of suitable quality. This is summarised in Figure 2. The full details of the consumption methodology can be found in Section 6.3.

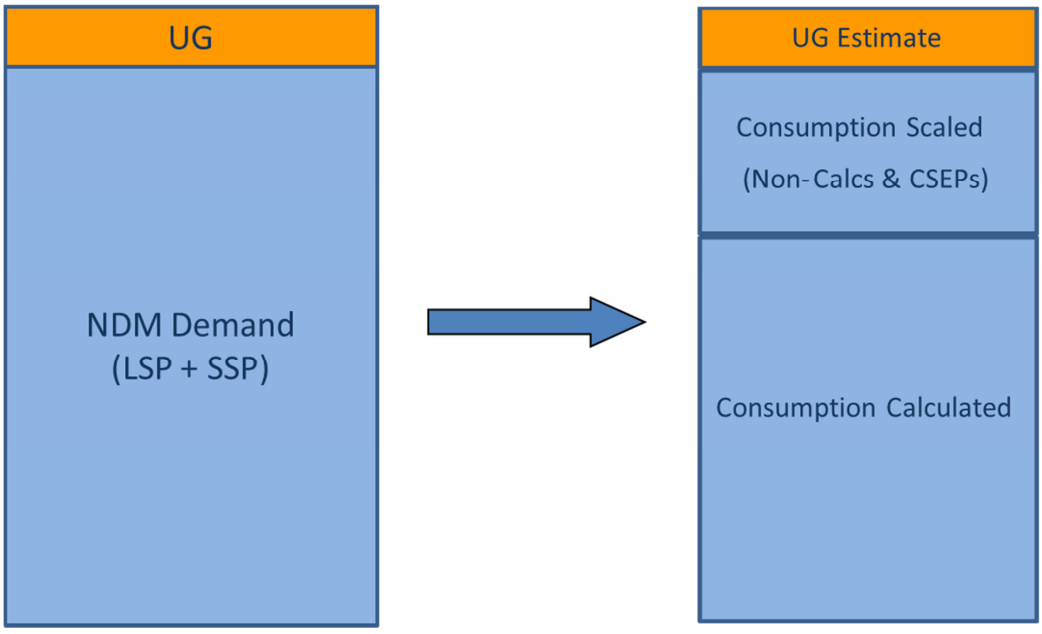

Figure 2: Calculation of Unidentified Gas from Consumptions and Allocations

This method is used to estimate total UG separately for each LDZ on a formula year basis. The process is used to estimate the total UG for each of the four most recent historic years for which reliable data is available. This excludes the most recent year as the number of meters where consumption can be successfully calculated is much lower due to fewer meter reads. The use of data from this year could therefore be subject to a large degree of uncertainty.

Note that at this stage the total UG figure contains both permanent and temporary UG.

3.3.2 Calculating Components of Total UG

Having obtained the total UG figure using the consumption methodology, the value of individual components that make up the UG total are calculated where this is possible. This also includes the calculation of the amount of this UG which is temporary for each component and how the UG is split between market sectors.

It is known that data for each of the five potential components of UG (Unregistered and Shipperless sites, iGT errors, Shrinkage error, Shipper-responsible theft and metering errors) is available. The availability and quality of this data varies from component to component, and the AUGE has therefore identified the best method of calculating each UG component based on the quality of information available for that component.

Brief descriptions of each UG element are given below.

1. Unregistered and Shipperless Sites

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. UG from this source is then calculated by assigning calculated consumption profiles to the validated AQ values from these sites. Unregistered and Shipperless sites that contribute to UG are split into the following sub-categories:

- Shipper Activity
- Orphaned Sites
- Unregistered <12 Months
- Shipperless PTS (Passed to Shipper)
- Shipperless SSrP (Shipper Specific Report)
- Without a Shipper <12 Months

2. IGT CSEP Setup and Registration Delays

IGT CSEP setup and registration delays should also be included in the UG calculation. UG from this source is due to gas 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 these unknown projects (number of sites and AQ split by market sector), and the number and AQ of unregistered sites associated with known projects.

3. Shrinkage Error

Shrinkage errors affect the Total UG calculation in that estimated Shrinkage is deducted from the LDZ input total (along with DM load) in order to give the total NDM allocation from which metered load is then removed to calculate total UG. The Shrinkage estimate comes from the Shrinkage Model, and if this is biased it will affect the UG estimate.

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. At the time they were trained they were, by definition, unbiased, and this may remain the case. If this is true, each individual instance of Shrinkage model error may affect the UG total that relies upon it, but these errors will even out over time, leaving a net effect of zero. If changing conditions over time have led to the Shrinkage model becoming biased, these effects will be picked up by the Balancing Factor (see 6 below), and this is therefore where this element will be captured.

4. Shipper-Responsible Theft

Very little reliable data on theft exists, 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 estimates from different sources vary widely, from 0.006% of throughput (based on detected theft only) to around 10%. As it is difficult to accurately estimate theft levels directly, undetected theft will be calculated by subtraction once known levels of detected theft have been accounted for. Undetected theft is part of the Balancing Factor (see 6 below), and considered over time, it forms the vast majority of that figure (based on an assumption that the Shrinkage models are unbiased, so their individual contribution can be positive or negative but will sum to a value close to zero over time).

5. Meter Errors

Meter errors can affect UG depending on their source. Errors in LDZ offtake metering and DM supply metering affect the estimate of total NDM demand including UG, whilst NDM LSP and SSP metering errors contribute to UG by affecting the NDM metered total. The AUGE has assessed this area and corrections are applied to LDZ offtakes, DM and unique site meters using detected error data supplied by Xoserve. In addition, the effects of consumer meters (SSP, NDM LSP and DM) under- and over-reading due to operating at the extremes of their range are modelled and included in the calculations.

6. Balancing Factor

The Balancing Factor is calculated by taking the difference between the calculated total UG and the sum of the directly estimated components. The Balancing Factor is comprised of UG elements that cannot be calculated directly because data is either unavailable or unreliable, and is believed to be mostly undetected theft.

The permanent component of total UG is then given by the sum of the Balancing Factor and the permanent components of the directly calculated components (see Figure 3).

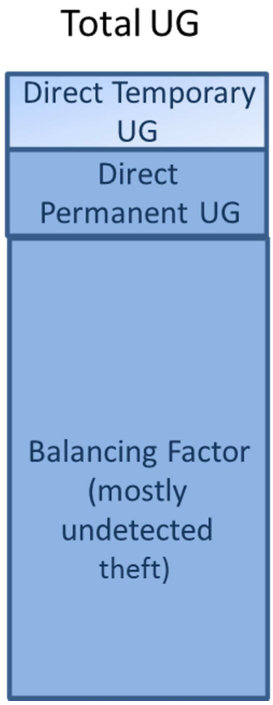

Figure 3: UG Components

3.3.3 Projection of Permanent UG to Forecast Period

Having calculated the best estimates of permanent and temporary UG for each historic year for which reliable data is available (the training period), it is then necessary to calculate the projected values of permanent UG for the forecast year (see Figure 4). Note that the estimated values for the forecast year are calculated based on seasonal normal weather. The projection is carried out individually for each UG component category and market sector, in each case using the most suitable data and extrapolation technique. Extrapolation to the forecast period is carried out for each of:

- Shipperless and Unregistered
- iGT CSEPs
- SSP and LSP Metering Errors
- Balancing Factor

The methods used differ based on the observed behaviour of each category of UG, and are in many cases affected by a number of UNC modifications introduced in order to address various UG issues. The Balancing Factor calculation uses only data from the four historic years with reliable meter read data (2009/10 to 2012/13), whilst the directly estimated components of UG use the most recent data available. Full details of the extrapolation techniques used in all cases are given in Section 6.9.

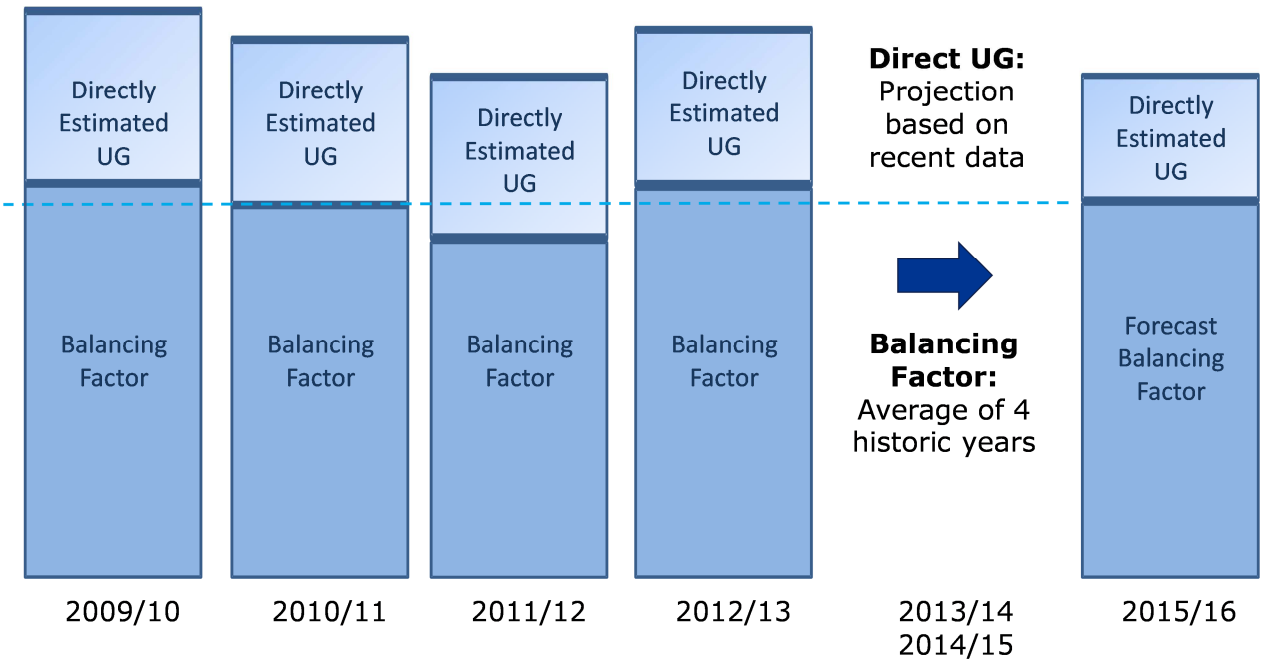

Figure 4: Projecting UG

As part of the estimation of the directly calculated UG components for the training years, an estimate of the amount of temporary UG for each component is made as described above. The values projected forward to the forecast year are the permanent part of the UG only, which is then apportioned to the SSP or LSP market sector (see Figure 5). Note that detected theft is treated as a directly measured component of UG (100% temporary).

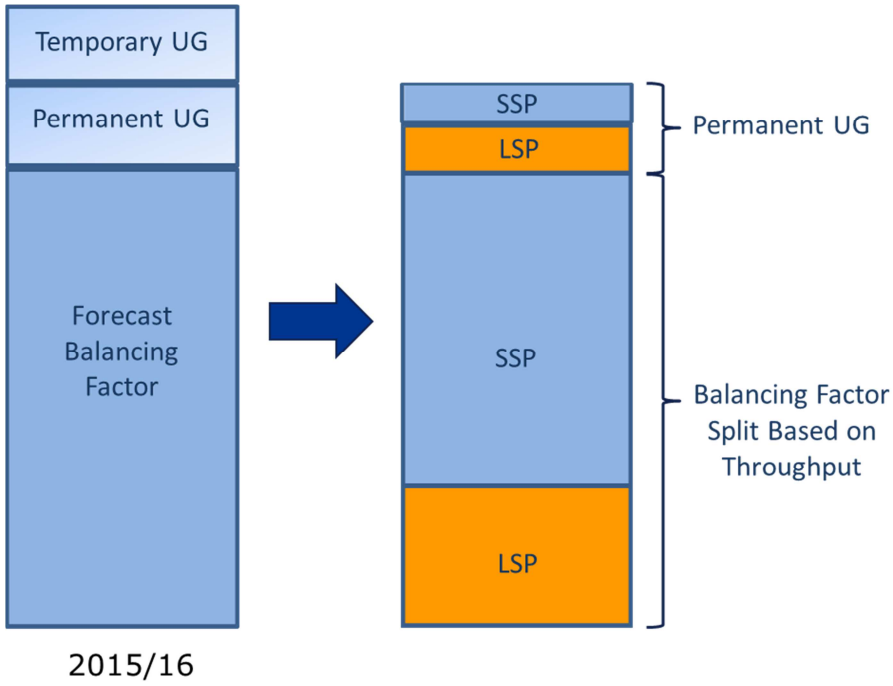

Figure 5: Projection of Permanent LSP UG

3.4 Materiality of Contribution from UG Components

Whenever a new component of Unidentified Gas is considered for inclusion in the calculations, or when changes to the calculations for an existing UG element are considered, a key element of the decision-making process is the *materiality* of the change in the UG estimate that would be produced. In this context, materiality consists of two considerations:

1. What would be the magnitude of the change in the UG figures produced by the updated calculation?
2. What level of confidence can be held in the new calculation and the data that underpins it?

Therefore, in effect the materiality criterion relates to the magnitude of the change compared to the confidence level.

The nature of the calculations precludes the production of statistically robust Confidence Intervals (CIs) for any UG category and so a direct comparison between the magnitude and a statistical CI cannot take place. There are two sources of error for each UG calculation and both need to be present for a proper CI to be produced:

1. Sample size compared to population size.
2. Uncertainty in the measurement of the data.

The first of these is not an issue: for many data items (such as Shipperless and Unregistered sites) we have data for the full population rather than a sample, whilst where we do only have a sample (such as in the Consumption Method) we know the size of it. No information exists on uncertainty, however, and it is present for all UG categories as the following examples show:

- For the Consumption Method, errors caused by incorrect reading/recording of meter values, meter roll-over, etc. Also, uncertainty caused by mapping between available meter readings and the UG year in question.
- For Unregistered sites, errors caused by incorrect AQs. Also uncertainty caused by estimation of the proportion of sites that flow gas whilst Unregistered and the proportion that can be backbilled.
- For iGT CSEPs, uncertainty caused by estimating the composition of Unknown Projects and estimating the population of Unregistered sites on known CSEPs from the number of notifications.

These issues cannot be quantified due to the lack of "actual" data – the information we already receive is the best that is available. Therefore a statistical CI cannot be calculated and the notion of "confidence level" in the materiality criterion becomes a subjective one.

Therefore, whenever a new UG category or a calculation change for an existing category is proposed, the AUGE will make an assessment of the likely magnitude of the change (in terms of the energy value of the UG involved) against the level of confidence that can be held in that calculation. Both areas of this assessment will be quantified as far as possible. Input will also be taken from the industry where appropriate, because the direct experience of the network code parties and their knowledge in certain areas can provide valuable information for the process.

In any event, the absolute minimum energy value that will be considered material is 4 GWh, and so changes that have a smaller impact than this will not be implemented. This threshold is a result of the uncertainty in the base data. Xoserve have confirmed that only meter corrections with a monetary value of £100,000 or more are reported and included in the datasets sent to the AUGE. This monetary value equates to approximately 4 GWh in energy at today's prices. Any changes whose impact is less than the known uncertainty in the meter data are considered negligible and hence will not be adopted. This threshold is an absolute minimum as in reality there will be a number of smaller meter errors

which haven't been accounted for which may sum to more than 4GWh. There are also other uncertainties within the base data.

Changes will therefore only be implemented if it can be demonstrated that they are likely to have a non-negligible effect (i.e. the best estimate of the resulting change to the UG estimate is at least 4 GWh), and that the confidence level does not swamp the best estimate (i.e. the likely range of values for the change does not include zero). This may result in smaller changes being made (where confidence is high) and larger changes being rejected (where confidence is low). Examples of this are as follows:

1. It is shown in Section 6.1 of this document that the maximum energy value associated with assigning Shipperless UG to the DM market sector is 4 GWh, and hence equates to the smallest possible change that can be considered material. This change will be made despite its small magnitude because the data used to calculate it is reliable and accurate.
2. In the same section it is reported that in the 2013 AUGS for 2014/15, the decision was taken not to include DM consumer meter errors in the UG estimates, despite the best estimate of its impact being much higher than the DM Shipperless case described above. This decision was taken because the consumer meter error analysis is based on hourly flows estimated from AQs, i.e. estimated hourly flow = AQ / (365 * 24). This is an unreliable method, although the best that can be implemented given the available data, and hence the uncertainty in the results from it is high.

Whilst the AUGE will seek industry input in assessing likely magnitude and confidence levels where appropriate, the final decision will always be the AUGE's own. The justification for each decision will be communicated to the industry, however, either through the AUGS or the query process.

4 SUMMARY OF ANALYSES

This section contains a summary of the analysis work carried out during preparation of the 2014 AUGS for 2015/16.

4.1 UNC Modification 0410A

Mod 0410A [20] was implemented on 01/09/2013 and has the potential to have an impact on all categories of Unregistered UG, i.e. Shipper Activity, Orphaned Sites and Unregistered <12 Months. The modification contains a number of different processes depending on the situation of each site (such as the date the MPRN was created, whether a Shipper or other party requested the installation of the meter, etc.). The key effects with regard to Unidentified Gas are as follows:

New Supply Meter Points

Where an MPRN is created after 01/09/2013, Shippers must ensure that a meter is not installed at the site unless a supply contract is in place. The process of registration is separate to meter installation and so this does not guarantee that the site will be registered on Xoserve's systems when it begins to flow gas, particularly if there is a delay in registration for some reason. It does mean, however, that even if the site is not registered it is more likely that it can be backbilled: sites cannot be backbilled if the confirming Shipper is different to the Shipper whose supplier requested meter installation, and this situation is less likely if a supply contract was in place when the meter was installed. Therefore, in theory, the proportion of temporary UG arising from this source should increase.

This modification will therefore impact immediately on the permanent element of Unregistered <12 Months. It will not reduce it to zero at any point, however, partly due to situation where the Shipper does change, and partly due to the fact that whilst in theory a meter cannot be installed without a supply contract being in place, in practice there are likely to be situations where this still occurs. This situation is accounted for in Mod 0410A and is described in more detail below.

The purpose of the modification is to reduce the magnitude of all Unregistered UG categories, and to ensure that the proportion of the remaining gas that is temporary in nature increases. As such, Shipper Activity and Orphaned Sites will be affected over time in addition to Unregistered <12 Months because the increased focus on Unregistered sites should result in fewer reaching 12 months and hence entering these other categories.

Meter Supply Points that remain Unregistered for more than 12 Months

Transporters will investigate any sites that have been created but remain Unregistered for more than 12 months, as of one year after the implementation of Mod 0410A (i.e. as of 01/09/2014). This investigation will take place regardless of whether there is any record of a meter being installed. The purpose of the investigation is to find any evidence that the site has a meter and is capable of flowing gas whether there is a record to this effect or not.

Where a Meter has been installed at a New Site but the Site remains Unregistered

If a meter has been installed at a new site at the request of a Supplier but the site has not been registered for three months, the Transporter will take action. For MPRNs created from 01/09/2013 onwards, in order for UNC not to have been breached there should be a supply contract in place (although in reality breaches will occur – this situation is covered below). Therefore the Shipper can be identified and they are required to register the site within a month. If they do not, the Transporter will register it for them. Once registration has taken place, the Shipper will be billed for any gas taken from

the meter installation date (asset meter read) onwards. For the UG calculations, these sites will still appear in the Unregistered Sites report whilst they remain unregistered, but the UG from them will be temporary in nature.

Where a Meter has been installed at a Site but there is no Supply Contract

This can happen without breaching the UNC if the MPRN was created before 01/09/2013 (i.e. before the implementation of Mod 0410A). Such sites appear in both Shipper Activity and Orphaned Sites, and prior to 01/09/2014 will also make up the Unregistered <12 Months category.

For MPRNs created after 01/09/2013, where a meter has been installed and there is no supply contract in place, the Shipper who requested the creation of the MPRN will be required to ensure that either a supply contract is put in place within a month, or that the meter is removed. Where the MPRN was not requested by a Shipper (e.g. where it was requested by a Transporter or Utility Infrastructure Provider), the relevant Transporter is responsible for instructing the consumer to procure a supply contract. If the MPRN was requested by a Shipper that is also the confirming Shipper then backbilling will occur and the UG from the site during the period it is unregistered will be temporary. In all other circumstances (i.e. change of Shipper, MPRN requested by another party, or no supply contract procured and meter disconnected) the UG will be permanent.

Unidentified Gas Modelling

In order to model the effects of Mod 0410A correctly it will be necessary to split the MPRNs that comprise the Unregistered UG categories into two elements:

1. Those where the MPRN was created before 01/09/2013 (and hence are not subject to Mod 0410A).
2. Those where the MPRN was created on or after 01/09/2013.

This is an equivalent process to that used in the 2013 AUGS for 2014/15 for Mod 0424 (where the Shipperless PTS population is split into those MPRNs recorded as having been Isolated before and after 01/04/2013). An important difference lies in how the modification is applied, however:

- Mod 0424 makes it *impossible* for any Shipperless PTS snapshot after May 2014 to contain any new MPRNs that contribute permanent UG. Hence the permanent element of Shipperless PTS after this date arises from a decaying legacy MPRN population only and it is modelled as such.
- The terms of Mod 0410A *should* mean that very few sites where the MPRN was created after 01/09/2013 remain Unregistered for more than 12 months and hence enter the Shipper Activity or Orphaned categories. If this is actually the case then both of these categories will consist only of legacy sites where the MPRN was created before 01/09/2013, and the decay of these populations can be modelled using the Mod 0424 approach. Mod 0410A *should* also result in immediate drops in the number and total AQ of sites not only in Unregistered <12 Months (which fewer sites should enter and those that do should be resolved far more quickly and hence disappear) but also in Shipper Activity and Orphaned (where the reductions in Unregistered <12 Months – particularly those MPRNs that have been Unregistered the longest – should result in fewer sites crossing the 12 month threshold and moving through).

  Analysis undertaken to date, based on snapshots from Sep 2013 to Jan 2014, indicates that no such reductions have yet taken place, however. This can be seen in Figure 6, Figure 7 and Figure 8 below, which show the number of LSP sites in each unregistered UG category from Jan 2013 to Jan 2014. Whilst Orphaned (Figure 7) shows a downward trend, this has been consistent across the whole time period and does not change from September 2013 onwards. Shipper Activity (Figure 6) shows a similar trend apart from the last point, which shows a sharp increase, and again there is

no change after September 2013 (except for that single point). In the case of Unregistered <12 Months, numbers have been rising and whilst they have dropped off very slightly in the Dec 2013 and Jan 2014 snapshots, the figures remain higher than they were in September 2013 rather than lower.

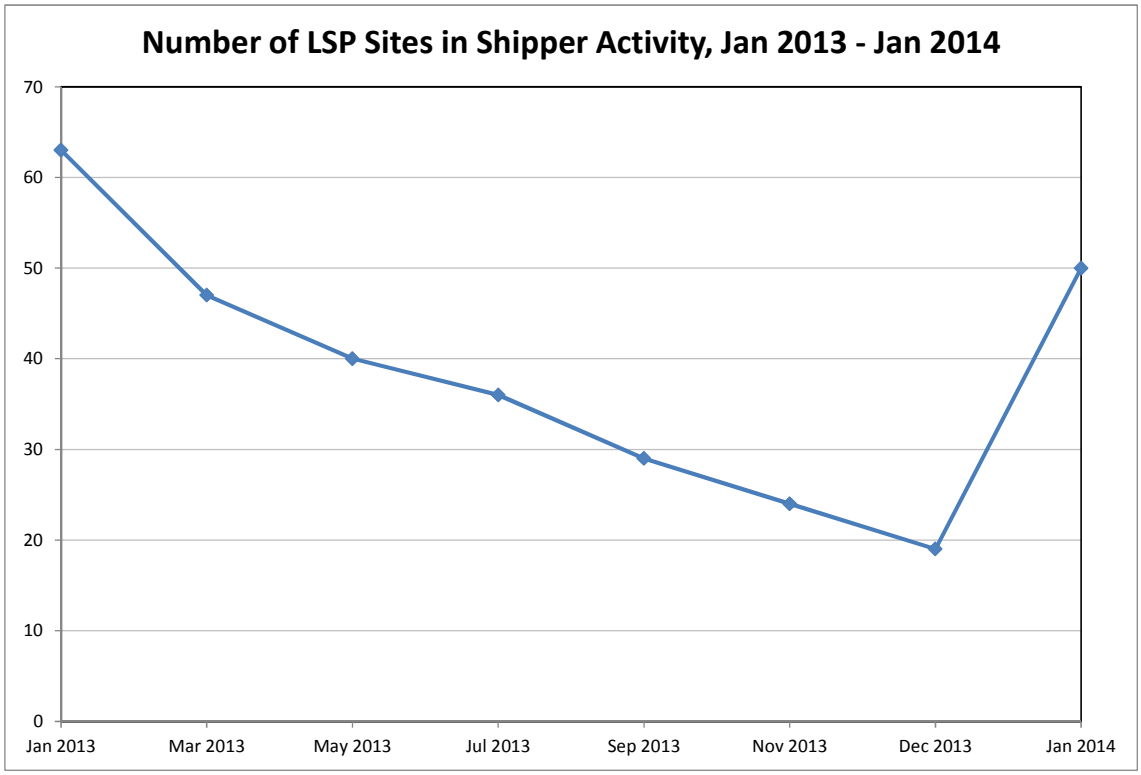

Figure 6: Number of LSP Sites in Shipper Activity under Mod 0410A

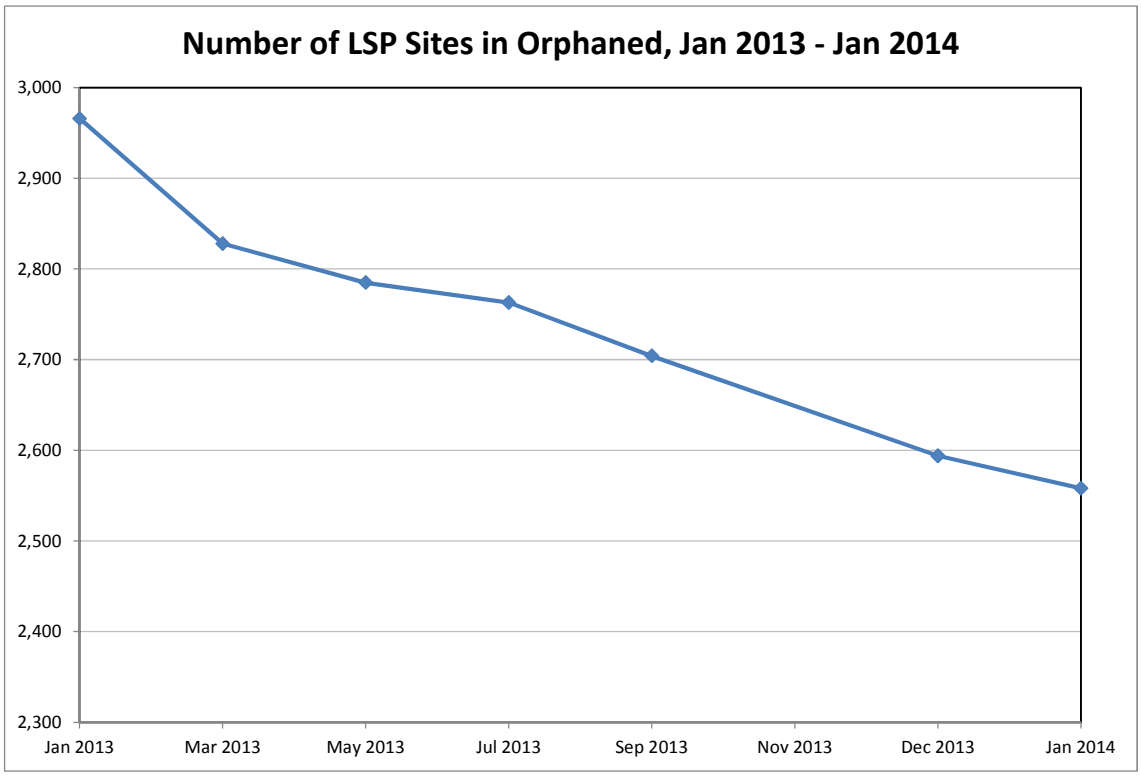

Figure 7: Number of LSP Sites in Orphaned under Mod 0410A

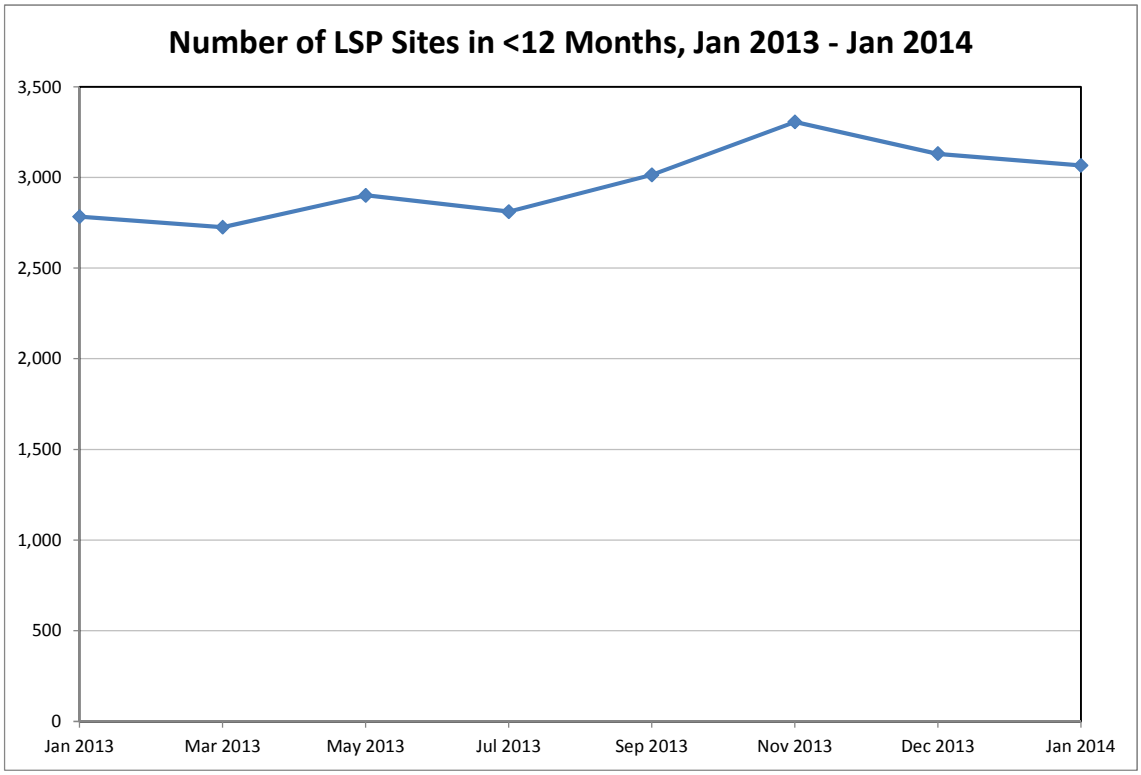

Figure 8: Number of LSP Sites in <12 Months under Mod 0410A

Further analysis will be undertaken using additional snapshots as they become available, but the current conclusion is that whilst Mod 0410A will result in more Unregistered MPRNs contributing temporary rather than permanent UG, it has not reduced the overall UG from this source. The approach to modelling for the 2014 AUGS for 2015/16 could therefore take a number of different forms, depending on whether the lack of reduction in total Unregistered UG continues.

- Whatever approach is taken, each Unregistered category will be split into two parts, as follows:
  - Those where the MPRN was created before 01/09/2013 (and hence is not subject to Mod 0410A)
  - Those where the MPRN was created on or after 01/09/2013 (and hence is subject to Mod 0410A)

  By the start point of the forecast year (April 2015):

  - The entire Unregistered <12 Months category will be made up of post-Mod 0410A sites, because sites created before 01/09/2013 will have been Unregistered for more than 12 months by this point and have moved into Shipper Activity or Orphaned.
  - Any site crossing the 12 month boundary into Shipper Activity or Orphaned at any point during the forecast year must also have been created after 01/09/2013, because sites created before this date will have been Unregistered for more than 12 months by this stage. Therefore the pre-Mod 0410A element of these two categories cannot grow and will consist only of decreasing numbers of legacy sites.

- The pre-Mod 0410A element of Shipper Activity and Orphaned will therefore be modelled with a decay curve using Mod 0424 (Shipperless PTS) techniques. This decay method is referred to in the step-by-step guide contained in 6.4 as **Method A**. The pre-Mod 0410A element of Unregistered <12 Months will be zero.
- If the Unregistered UG total drops such that after September 2014 only legacy pre-Mod 0410A MPRNs remain in Shipper Activity and Orphaned, the post-Mod 0410A elements of these categories will, by definition, be zero. If the Unregistered UG total does not drop in this way (i.e. either it does not drop at all or drops but to a level where new sites are still entering Shipper Activity and Orphaned), the **total** (i.e. combined pre- and post-Mod 0410A) for these UG categories will be modelled using current techniques. An assessment will be made of the most appropriate method to use for extrapolation to the forecast period: this could be to use the average for the training period (the current method), to take forward the n most recent snapshots only (to account for a step change to a new steady level in the middle of the training period), or to use a trend (if there is an ongoing downward movement throughout the training period). The post-Mod 0410A element will then be calculated by subtracting the pre-Mod 0410A element from the total. This method of modelling the effects of Mod 0410A using traditional techniques is referred to in the step-by-step guide contained in Section 6.4 as **Method B**.
- The Unregistered <12 Months category (which will consist entirely of the post-Mod 0410A element for the forecast year) will continue to be modelled using current techniques, but the most appropriate extrapolation method will be assessed and applied (i.e. training average, recent training snapshots or trend). This element therefore will always use **Method B**.

The permanent/temporary split for both pre-Mod 0410A and post-Mod 0410A sites is carried out using the proportion of sites that can be backbilled. Mod 0410A is likely to increase this proportion, as described above, and hence two versions of the factor will be produced: one applicable to MPRNs created before 01/09/2013 and one applicable to MPRNs created after this date.

Figure 9 below shows the options described above in flowchart form. In this chart, the two different factors are labelled "V1" and "V2".

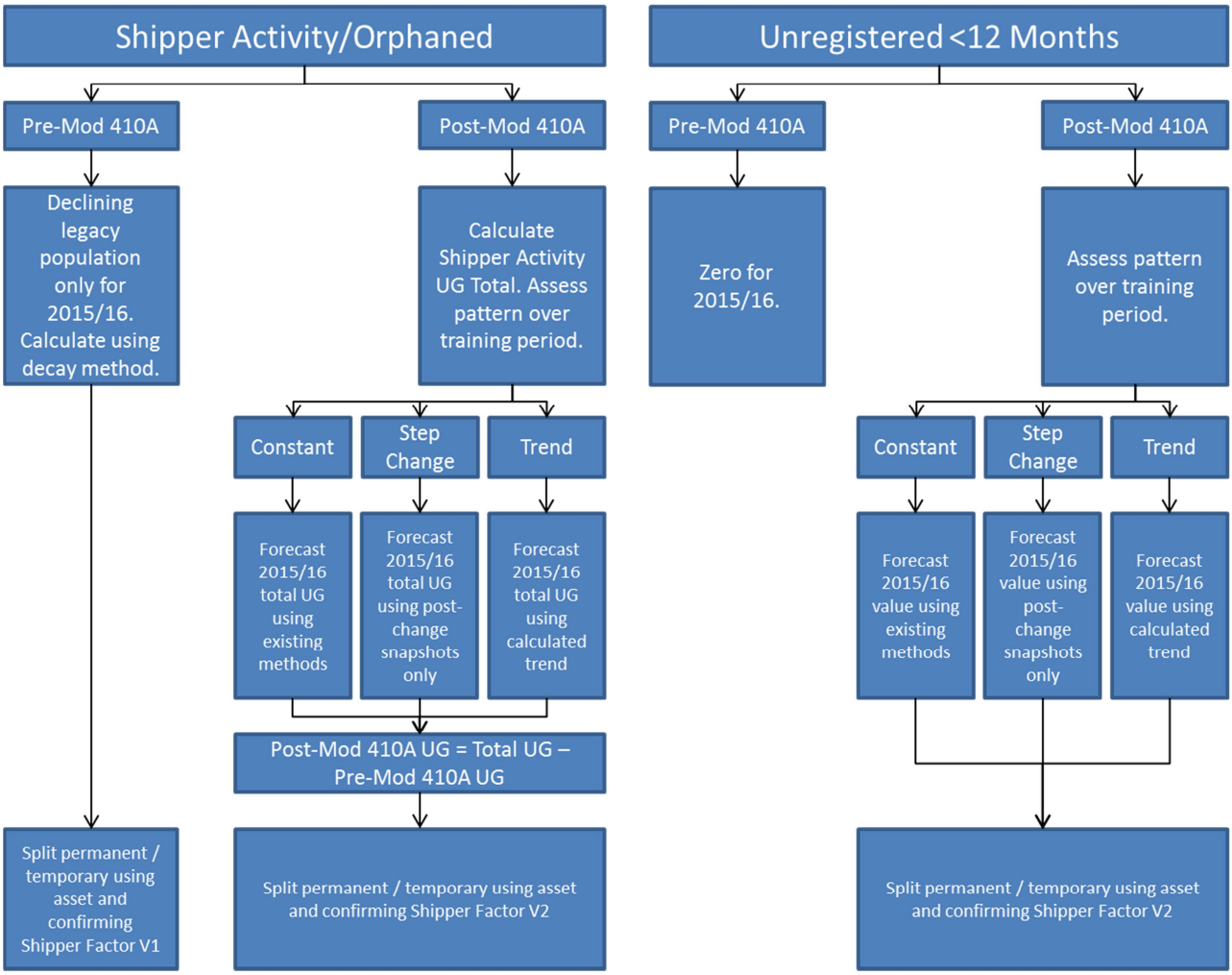

Figure 9: Mod 0410A Calculation Options

It will only be possible to draw definitive conclusions about the flow of post-Mod 0410A sites into Shipper Activity and Orphaned from the September 2014 snapshot onwards because this is the point at which the first post-Mod 0410A sites will reach the 12-month threshold. Snapshots now contain a "MPRN Creation Date" field and this can be used to analyse the behaviour of pre- and post-Mod 0410A sites. In order to comply with the AUGE timescales, however, the UG calculation method must be defined before this point.

Therefore, in order to allow a decision to be taken when the required data is present, alternative versions of the method are presented in this document. The most appropriate of these options will be chosen for the final calculations based on the most up-to-date information available at the time the UG estimates are made.

The key difference between pre-Mod 0410A MPRNs and post-Mod 0410A MPRNs is the calculation that classifies the UG they consume into its temporary and permanent elements. In both cases the current *logic* remains in place - that is, the UG is temporary if the confirming Shipper is the same as the Shipper whose Supplier requested asset installation, and permanent otherwise. The difference lies in the frequency with which this situation arises. The terms of Mod 410A should result in a change in the proportion of sites that can be backbilled and hence pre-Mod 0410A MPRNs and post-Mod 0410A must be modelled separately in five stages:

1. For each snapshot, the MPRNs are split into two groups for each Unregistered UG category
   - created before 01/09/2013
   - created on or after 01/09/2013
   This is done using the "MPRN Creation Date" field now supplied in the snapshots.

2. The "Connection Details for Orphaned Sites" dataset is also split on this basis and two different figures for "Fraction of UG not Backbilled" are produced, one for the pre-Mod 0410A dataset and one for post-Mod 0410A.

3. A traditional UG calculation is carried out for Unregistered <12 Months. The method of extrapolating to the forecast year (training average, recent training snapshots, trend) is chosen based on any observed trends in total UG from this category across the training snapshots. For the forecast year the category will consist of post-Mod 0410A sites only and the permanent/temporary split will be based on the appropriate "Fraction of UG not Backbilled" factor.

4. The decay method is used for the pre-01/09/2013 group for Shipper Activity and Orphaned, and these two categories are modelled using the churn method developed for Mod 0424 (Shipperless PTS). The decay curve starts with the September 2014 snapshot and so the whole forecast year (2015/16) lies in the decay period. Whereas for Mod 0424 the Shipperless PTS total remains the same and the decay curve is used to derive the changing permanent/temporary split, for Mod 0410A the decay curve is used to derive the UG total from this source, and this is then split between permanent and temporary using the factors used in the current analysis.

5. If it is determined that post-01/09/2013 sites continue to enter Shipper Activity and Orphaned, the traditional method will be used to model the category totals and the post-Mod 0410A element will be calculated by subtraction. The method of extrapolating the total to the forecast year (training average, recent training snapshots, trend) will be chosen based on any observed trends in total UG from this category of site across the training snapshots. The permanent/temporary split of the post-Mod 0410A element will be calculated using the appropriate "Fraction of UG not Backbilled" figure.

The final method for calculating all categories of Unregistered and Shipperless UG, incorporating this approximate method for taking into account the effects of Mod 0410A, is described in Section 6.5 of this document.

4.2 UNC Modification 0425V

Modification 0425 [16] aims to reduce the impact of Shipperless SSrP sites on Unidentified Gas and was implemented with effect from 1 April 2014. It places an obligation on the last registered Shipper to take responsibility for investigation and resolution of the registration of the site in circumstances where the GSR visit finds a new meter in place and capable of flowing gas. This modification will be treated in a similar manner to Mod 0424 using information currently provided by Xoserve.

Mod 0425 is slightly more complex than Mod 0424 because it deals specifically with sites where a new meter is found during the GSR visit rather than the existing meter. This introduces the potential unknown of when that new meter was installed. This extra level of complexity only has the potential to affect the "Without a Shipper <12 Months" UG category, for reasons explained below.

Details for each UG component associated with this modification are as follows.

Shipperless SSrP UG:

Under the terms of Mod 0425, any meter point that was Isolated after 01/04/2014 and is subsequently found at the GSR visit to have a new meter that is capable of flowing gas will be backbilled to one of two points:

1. If it is known, the installation date of the new meter, or
2. If the installation date is unknown, the date of notification to the last Shipper: this notification will take place when the GSR visit has found a meter at the site, and therefore this point equates to the date of the GSR visit.

In order for the site to appear in the Shipperless SSrP report, the new meter must, by definition, be at the site and therefore the entire time that the site is present in the Shipperless report lies after both the installation date (if known) and the Shipper withdrawal date. Therefore all gas for sites Isolated after 01/04/2014 arising from the Shipperless SSrP report is temporary in nature.

This means that Mod 0425 for Shipperless SSrP can be modelled using exactly the same principles as used for Mod 0424 for Shipperless PTS. The effective date of Mod 0425 is 01/04/2014 and therefore, due to the one-year window before the GSR visit takes place, the last snapshot that can contain new permanent UG (i.e. that from sites Isolated before 01/04/2014) is May 2015.

Therefore the permanent/temporary split of the May 2015 snapshot can be estimated and the decline of the permanent element over the 2015/16 formula year can be modelled using the Mod 0424 techniques described in Section 6.4 of this document. For each snapshot in the analysis period, this estimated permanent element is subtracted from the total and the remainder of the UG is temporary.

Without a Shipper <12 Months

The sites in this category have been recorded as Isolated for less than 12 months. They will either be re-registered with a Shipper or, if 12 months elapses and the GSR visit takes place, they will become part of either the Shipperless PTS or SSrP categories.

The calculation process for the Shipperless PTS element of this UG category (i.e. those sites which will move into the PTS category after the GSR visit) is dependent on the assumption that when the meter in question was recorded as having been disabled/removed this did not actually happen: hence the meter was in place for the full year from the disablement/removal record date to the GSR visit and hence inclusion in the Shipperless report.

The Shipperless SSrP element is more complex in that the meter was actually disabled/removed at this point (and if it was simply disabled at this stage it was physically removed at a later date). At some point between the disablement/removal record and the GSR visit, a new meter was installed and is capable of flowing gas, but the date of installation is not necessarily known. In order to account for this, an extra step is required in the calculation for the Shipperless SSrP element of this UG category compared to the Shipperless PTS version.

Two new factors need to be introduced into the Shipperless SSrP calculation to account for this, as follows:

- Proportion of SSrP meters without an install date record
  This is used to distinguish between those sites that can be backbilled for their time in the "Without a Shipper <12 Months" UG category (i.e. those where the install date of the new meter is known), and those that cannot and hence still consume permanent UG (i.e. those without an install date). Preliminary analysis indicates that the vast majority of Shipperless SSrP sites do not have a meter install date recorded.

- Proportion of year that new meter is present
  The GSR visit takes place a year after the Isolation of the meter. For sites that go on to become Shipperless SSrP, the new meter must be installed at some point during this year, but in the vast majority of cases the date is unknown. If it is assumed that such meters are installed at a steady rate throughout the year, this equates to a situation where each meter has been present for an average of six months (i.e. a factor of 50%). This is the value used in the analysis.

Therefore, in the calculations of "Without a Shipper <12 Months", the permanent/temporary split is calculated using the following steps:

1. Calculate total SSP UG and LSP UG (permanent plus temporary) for "Without a Shipper <12 Months" using the method described in Section 6.4 below.
2. Split the market sector totals into UG that will become Shipperless PTS and UG that will become Shipperless SSrP using factors based on the relative size of these UG categories. Different factors are used for each market sector.
3. For the 2015/16 gas year, the Shipperless PTS element of Without a Shipper <12 Months can be backbilled under the terms of Mod 0424 and is hence fully temporary.
4. For each market sector, multiply the Shipperless SSrP element by the "% of Year with Meter" factor. This gives the total (permanent plus temporary) UG for the Shipperless SSrP elelement of "Without a Shipper <12 Months".
5. For each market sector, multiply the totals from Step 4 by the "% of Meters without Install Date" factor. This gives the permanent element of the UG total. The remainder of the UG for the Shipperless SSrP elelement of "Without a Shipper <12 Months" is temporary.

4.3 UNC Modifications 0398 and 0429

Mod 0398 [7] was discussed in the 2013 AUGS for 2014/15 [29] but is described again here due to the relationship between Mod 0398 and Mod 0429 [14] which was implemented with effect from 1st April 2014.

The implementation of Mod 0398 on 1 April 2014 [21] reduces the reconciliation window to 3-4 years. In line with this modification, a backstop date of 3 years will be set at 1 April each year. This backstop remains for the whole year giving an increasing reconciliation window as the year progresses, up to a maximum of 3 years 364 days before the backstop is then reset to 3 years for the following year.

Some UG is temporary in nature i.e. it is resolved through the reconciliation process. Reducing the reconciliation window could result in more UG, which would otherwise be temporary, becoming permanent than is currently the case.

The final modification report for Mod 0398 includes data from Xoserve which shows that the difference in the amount of unreconciled energy between years 3-4 and 4-5 is small. It would also be anticipated that Shippers would make every effort to ensure that issues are resolved within the new reduced time window. The report concludes "Reducing the reconciliation window would therefore have a minimal impact on energy allocation". The AUGE would therefore expect the impact on UG to be correspondingly minimal.

The modification report did recognise that Significant Meter Errors (SMEs) could be an issue as these may be large and can take a long time to resolve. Ofgem noted in their decision letter regarding Mod 0398 [21] that "Several respondents raised concerns about the impact UNC 0395 or UNC 0398 may

have on the accurate reconciliation of Significant Meter Errors ('SMEs'), particularly in relation to a NTS-LDZ offtake meter given the length of time that an error may go undiscovered and subsequently take to resolve".

Modification 0429 [14] seeks to address the mismatch between the reconciliation window and the Limitation Act (6yrs) by the creation of a claims process for Shippers to use when major loss is incurred in the gap between the end of the reconciliation window and the Limitation Act. Mod 0474S is currently under review and provides guidelines for Mod 0429. The energy adjustment under Mod 0429 will be made through neutrality i.e. shared across all energy balancing parties. The result is that any significant errors that Mod 0398 would have prevented the UG calculations taking account of (because they fall outside the shortened reconciliation window) will now be able to feed into the process as a result of Mod 0429. However, Mod 0429 does not cover NTS-LDZ offtake meter errors.

As Mod 0429 can affect the estimate of total permanent UG from the consumption method, it is proposed that the calculation of UG for the historic years is adjusted to take account of any successful claims made using it. Xoserve will provide details of the quantity of energy claimed and the period over which the error occurred. This will allow the AUGE to apportion this energy between the gas years where the error was occurring, using a similar method to that currently used for adjustments that fall within the reconciliation window. This data will then be used to adjust the total UG estimate as described in 6.2 (Correcting the NDM Allocation).

4.4 UNC Modification 0431

This modification seeks to improve the completeness of the data held by Transporters on behalf of industry parties by carrying out an MPRN portfolio reconciliation between Shipper records and Sites & Meters. This modification has been implemented with effect from 1 May 2014.

It may impact on the Shipperless and Unregistered UG totals if the Xoserve reconciliation analysis returns a large number of MPRNs that are listed as Unregistered or Shipperless on their systems but are in reality being supplied by a Shipper. If the number of sites found is consistent with the general month-to-month churn in such sites then there will be no impact.

If the number of sites found is large enough to impact on the UG results, this will create a downward step change in the level of Unregistered and/or Shipperless UG once the reconciliation analysis has been completed and the results implemented. This will occur partway through the period of historic data used for the 2015/16 UG calculation. Under this scenario it will be important that the UG level fed through to the forecast year represents the lower level from the latter part of the training period rather than the higher level at the start or a combination of the two.

Therefore, the AUGE has requested that once Xoserve have carried out their reconciliation analysis, a full list of dummy MPRNs that were in the Shipperless/Unregistered report but were found to be being supplied by a Shipper is provided. A list of such MPRNs will be supplied for each Unregistered and Shipperless category. If the effect of these sites becoming registered is significant, the lists of dummy MPRNs will be used to remove these sites from whatever snapshots they appear in prior to the calculation of the Unregistered and Shipperless UG figures. This will ensure that only the post-reconciliation element of UG is present across the whole training set, which will reflect the conditions in the forecast year.

In addition, if Found Meters (meters being supplied by a Shipper but for which Xoserve have no record) are discovered this will affect the total UG calculated by the consumption method. At present, all gas consumed by such unknown sites goes into the Balancing Factor. A Found Sites report will also be

supplied by Xoserve once the reconciliation analysis is complete, and this will be used in the consumption analysis. Given that meter read data will not be available for Found Meters, these will form part of the non-calculated population (i.e. that part of the total population for which average EUC consumption is used because figures could not be calculated directly from metered volumes).

4.5 UNC Modification 0469S

Mod 0469S aims to reduce the number of Shipperless sites and the time period for which sites are Shipperless by introducing a reporting process following transporter GSR visits. The modification is currently being evaluated by the industry so no further analysis will be taken by the AUGE at this stage.

4.6 Impact of Changes to Supplier Licences to Increase Theft Detection Rates

From 8 Jan 2013, Ofgem introduced changes to Supplier licences to increase theft detection rates [27]. There is an expectation that the number of detections will increase from 3,000 to 6,000 per annum [28].

In the current AUGS methodology [29], detected theft by year of occurrence is deducted from the total estimate of UG. This is approximately 20-25 GWh/yr based on theft data to end of June 2012.

From the consultation of the previous draft AUGS it was suggested that this figure be increased to account for the higher theft detection rates following the Ofgem changes to Supplier licences. In the previous AUGS [29], it was suggested that no change be made to the UG calculation methodology due to lack of supporting evidence for the expected increases in theft detection rates and the low materiality of the issue. It should also be noted that increasing the *number* of detected thefts may not increase the *amount* of theft by the same proportion. There is an argument for the case that the larger thefts are already being identified, as these are easier to detect and there is more of a financial incentive to resolve them. An increase in the number of detections will therefore be likely to be due to the identification of additional smaller thefts.

A further analysis of theft data has been carried out. Figure 10 shows that there does in fact appear to be a small increase in the level of detected theft. This shows a rolling 12 month theft detection rate (to remove any month on month variation) and is based on data published on the Gas Governance website [33]. It should be noted that the theft reports published on the website show higher levels of theft than data provided to the AUGE by Xoserve. Xoserve have confirmed that the published data may contain a number of invalid and duplicate records which are removed from the datasets provided to the AUGE.

Although this shows a small increase in the number of detections, many of these will be for gas thefts over a number of years. These theft quantities will therefore already be accounted for in the current theft calculation approach, as this is based on theft by year of occurrence. Detected thefts are used to reduce the permanent UG in each of the historic years used to estimate the Balancing Factor, which is then used to estimate the Balancing Factor for the forecast year. Given the low materiality of this and the uncertainty about whether, and by how much, theft detection rates will continue to grow, it is proposed that no further adjustment to the methodology is made at this time.

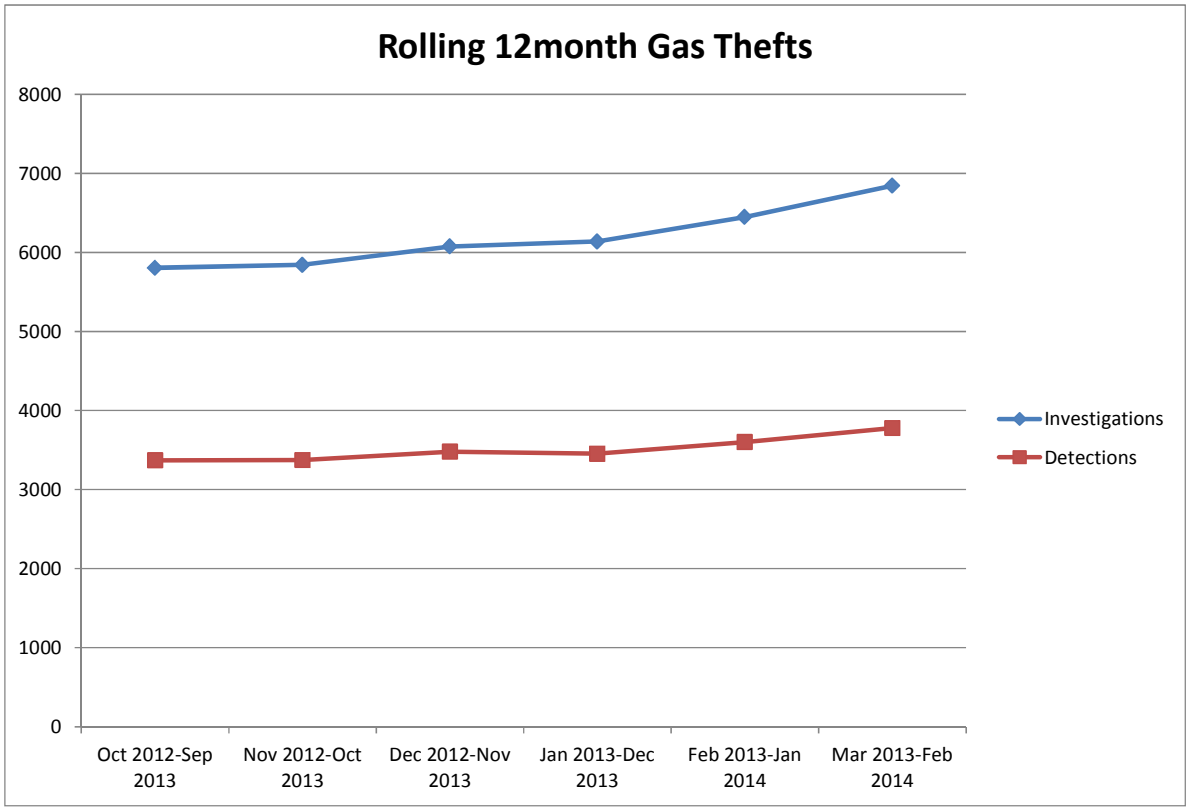

Figure 10: Theft Detections and Investigations Oct 2012 – Feb 2014

4.7 CSEP Consumption Estimates

During the consultation period following the issue of the 2014 First Draft AUGS for 2015/16, British Gas raised a query regarding "Inaccurate calculation of CSEP consumption" [36]. British Gas highlighted the fact that the default AQ values in the NExA table used for new domestic properties on CSEPs had reduced by about 20%. They therefore asserted that some sites would have their AQ (and therefore consumption) over-stated as a result and that this would lead to a corresponding under-estimate of total UG.

Based on the AUGE's understanding of the issue and data readily available, an order of magnitude calculation was performed to assess the materiality. The initial estimate of the impact on total UG was that it could increase by around 117 GWh/yr.

At the UNCC meeting on 30 June 2014, the AUGE requested further information from the industry to allow a more detailed analysis. Some clarifications were also given at this meeting which affect the basis on which the AUGE made their initial estimate of the impact of this issue

1. The AUGE's initial estimate of the materiality was based on new 01B meters prior to having their AQ successfully calculated during AQ review. British Gas confirmed that they believe that other 01B meters could also be subject to a bias in AQ if they have not successfully recalculated during AQ review.
2. The AUGE's initial estimate of materiality assumed that 4% of the AQ over-statement referred to in British Gas's response was the result of the change to the definition of seasonal normal temperature. Scottish Power stated that they did not believe that the WAALPs used were based on the new seasonal normal definition. Scottish Power's presentation on the AQ

update [35] suggests this is indeed the case as the data used is from before the change to the seasonal normal update.

In order to address the concerns raised by British Gas, a review of the use of CSEP AQs as a proxy for consumption has been carried out. A more detailed CSEP consumption estimation process has been developed and is described below.

4.7.1 Overview

Xoserve hold only limited data regarding CSEP consumption. The only option is therefore to base consumption estimates on aggregate AQ values. For 2014/15, the AQ was used directly as a proxy for consumption. The proposal for 2015/16 is based on AQ, but seeks to remove the inherent bias in AQ resulting from the lag between the meter reads used to calculate the AQ and the AQ value becoming effective. The lag is exaggerated for SSP meters on CSEPs, as these are initially given a default AQ from the CSEP NExA table which may be several years old.

The proposed methodology for estimating CSEP consumption is shown in Figure 11. It uses two datasets as follows

- CSEP aggregate AQ and Meter Point count by EUC from the ODR1209 report. This information is available from Xoserve
- Success rate of CSEP AQ recalculations during AQ review. This information is not held centrally and will be requested from shippers

The ODR1209 report provides details of the change in aggregate AQ between years following AQ review. The change in AQ for each LDZ and EUC is made up of two components. Firstly, as a result of new meter reads, the AQ of an existing meter may change. Secondly, there will be a change in the set of meters connected to the CSEP. As the ODR1209 report only gives the total number of meters, it is not possible to distinguish between new and lost meters but only to see the net change. When a new meter is connected to a CSEP it is given an initial AQ. This is the default AQ value from the CSEP NExA table for domestic properties or a shipper estimate for all others.

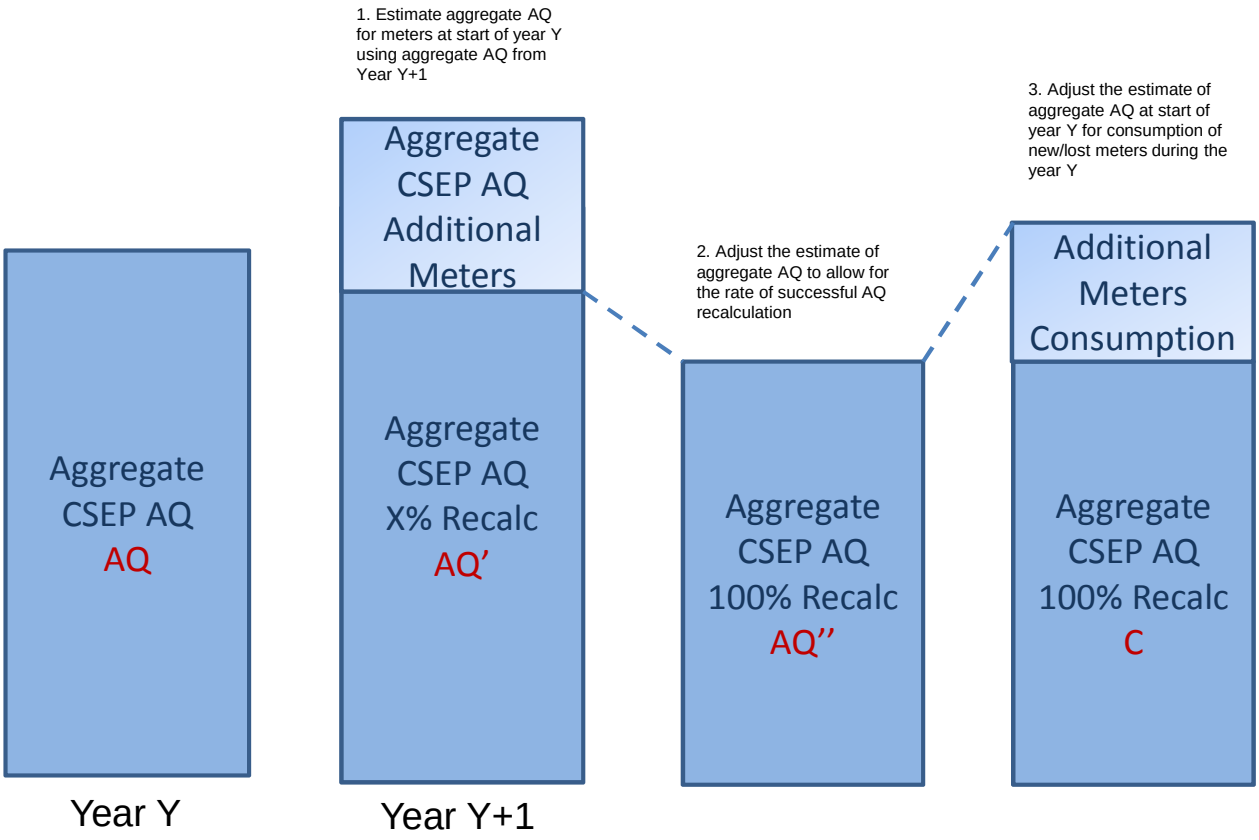

Figure 11: CSEP Consumption Estimation Process

The proposed methodology uses the aggregate AQ for gas year Y+1 as a 'best' estimate of aggregate AQ for the formula year Y, as this takes account of the lag between AQ recalculation and meter reads. This is because the timing of the AQ review process means that the meter reads used are likely to lie within the previous formula year. However, this aggregate AQ value must be adjusted to account for changes in the number of meters making up the aggregate AQ. This is step 1 shown in Figure 11.

The resulting aggregate AQ (AQ') is then further adjusted to allow for the fact that not all AQs are successfully recalculated at AQ review. This is step 2 shown in Figure 11.

The final step in the calculation process (step 3 in Figure 11) involves estimating the consumption for year Y (C) by adding in the estimated consumption from changes in the number of meters within the CSEP over the year.

4.7.2 Calculation Details

The following 3 steps are used in the calculation of CSEP consumption for formula year Y and are shown in Figure 11. The actual formulas applied are given in 6.3.3.1. The steps are carried out separately for each LDZ and EUC. All references to AQ mean the CSEP AQ for the corresponding LDZ and EUC unless stated otherwise. In cases where there are fewer than 100 meter points, the calculation may be unreliable. In this case, the aggregate AQ for year Y is used as the best estimate of consumption for year Y (as previously)

1. Estimate the aggregate AQ for existing meters in year Y from AQ for year Y+1 (AQ')

This is done by subtracting an estimate of the AQ change due to new/lost meters from the aggregate AQ for year Y+1. Year Y+1 is used as the meter reads used in the Y+1 AQ calculations are more representative of year Y. The change in the number of meters between year Y and Y+1 is multiplied by an average meter AQ (total aggregate AQ/number of meters), which is one of the following

- If the number of meters has increased and the EUC is 01B then use a default AQ value to represent the default value in the CSEP NExA table. The value used is the average meter AQ for 2007
- If the number of meters has increased and the EUC is not 01B then use the average meter AQ from year Y+1
- If the number of meters has decreased, use the average meter AQ for year Y

2. Adjust the estimate of aggregate AQ to allow for recalculation rate (AQ'')

   The difference between the AQ for a year (AQ) and the estimated AQ following the AQ review adjusted for the changes in number of meters (AQ'), represents the change in AQ over the year. However, this change is the result of only some of the meters having their AQ successfully recalculated. It is therefore necessary to apply a further correction to scale the AQ change to represent the AQ change assuming a successful recalculation rate of 100%. This correction is based on the assumption that any change in AQ for successfully recalculated meters also applies to meters where AQ is not updated.

   This step of the calculation also takes into account the change in AQ which resulted from the new definition of Seasonal Normal Composite Weather Variable (SNCWV) which was introduced in 2010. When estimating the consumption for 2009, AQ data from 2009 and 2010 are used. These AQs are not directly comparable as they are based on different SNCWV definitions. To allow for this discrepancy, the 2009 AQs are adjusted to be on the same basis as the 2010 AQs using factors provided by Xoserve. This adjustment is only used for 2009.

3. Adjust for new/lost meters to obtain consumption estimate (C)

   The adjusted AQ calculated in step 2, AQ'' represents the best estimate of the aggregate AQ for meters present at the start of year Y. The change in the number of meters between year Y and year Y+1 is then used to adjust this for the meters gained or lost during the year based on the assumption that on average they will be consuming for 6 months.

   Although it is assumed that the meters will be consuming for 6 months, as the formula year runs from April any new meters added will be more likely to be consuming during the winter (the end of the formula year). Conversely, meters which stop consuming are more likely to have had any consumption during the summer (the first half of the formula year). This difference is accounted for by assuming that consumption from new meters will be 0.75*AQ whilst those from lost meters will be 0.25*AQ i.e. assuming that winter consumption is approximately double summer consumption.

5 DATA USED

This section describes the data requested, received and used to derive the methodology to calculate UG. The AUGE has 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 in previous years. This was partly to do with the way the industry manages various processes. For example, the AUGE could not obtain a history of data relating to Shipperless/Unregistered sites over time as only current snapshots can be produced. However, Xoserve now provides regular snapshots so that trends can be identified over time.

In 2012 there were issues obtaining meter reads and metered volume data, and this is described in previous versions of the AUGS. Data provision was improved in 2013, allowing the AUGE to generate interim and final AUG tables in accordance with the AUGE guidelines timetable. Data requests for 2014 have been submitted to Xoserve and data preparation is underway, and the AUGE does not anticipate any significant issues with data provision this year.

Section 5.1 below gives a summary of the data items requested and their current status. The subsequent sections give more details about the data items for each individual element of the analysis.

As part of the AUGE's quality control process, a number of standard data checks have been defined which are run prior to performing any consumption calculations. Any anomalous data will be reported to Xoserve for further investigation. It is unlikely that all issues identified will be resolved prior to final calculation of the AUGS table, so by necessity this will be based on the best data available. There are also a number of checks during the calculation process to ensure that where data is unreliable it will not be used in the estimation of UG.

5.1 Summary

Table 3: Data Status Summary

Analysis Area	**Required Dataset**	**Status**
Total UG Calculation	Allocated NDM allocations	Received
	Metered SSP and LSP loads	Received
	LDZ, DM and Unique Sites Metering Errors	Update requested
	Adjustments from successful claims made under Mod 0429	Requested
	Meter Asset Information	Received
	Algorithm data (ALPs, DAFs, EWCFs)	Received
	CV data	Received
	CSEP AQ data	Received
	Non-CSEP AQ data	Received
	MMSP details	Received

Analysis Area	Required Dataset	Status
	Prime and Sub-Prime meter details	Received
	New and Lost Sites	Received
Unregistered and Shipperless Sites	Connection details for orphaned sites	Update requested
	Gas Safety Regulations visit data	Update requested
	Further investigation results for large/suspicious sites	Supplied on request
	Mod 0410A supporting data	Ongoing
	Shipperless sites supporting data	Update requested
	Snapshot files (including MPR details)	Ongoing
iGT CSEPs	Known CSEP data	Update requested
	Snapshot files	Ongoing
Meter Error	Meter capacity report	Received
Theft	Detected and alleged theft updated to end March 2014	Received

5.2 Total UG Calculation (Consumption Method)

Data has been requested from Xoserve in the following formats. In all cases, data has previously been provided for the time period 01/04/2008 to 31/03/2013. Any updates/corrections and the supply of data for the 2013/14 formula year are ongoing.

- Allocation data on a day-by-day basis, split by End User Category (EUC). This data includes CSEP allocations.
- Meter read data on an MPRN-by-MPRN basis, with one record for each meter read. Therefore, the volume of data supplied for each MPRN is dependent on the meter read frequency for that meter.
- Aggregate meter error adjustments for LDZs, DMs and Unique Sites.
- Mod 0429 claims data. Time period and total energy quantity for all successful claims made under Mod 0429.
- Meter asset information on a MPRN-by-MPRN basis. This includes meter installation dates, metric/imperial flag, numbers of meter dials, meter index units and T&P correction factors. This information is used in a number of different parts of the consumption algorithm.
- NDM Deeming Algorithm factors and CVs for the analysis period.

- Aggregate MPRN count and AQ data by EUC for CSEPs. Meter read data is not available for these sites, but knowledge of the number and AQ of MPRNs allows them to be included in the total UG calculations when the sample consumption is scaled up to cover the full population.
- A history of AQ and EUC data for each MPRN so that calculated consumptions can be validated against AQs and failed meter points can be replaced with an appropriate EUC average.
- Details of all meter points which are or have been part of a MMSP during the analysis period.
- Details of all meter points which are or have been part of a Prime/Sub-Prime configuration during the analysis period.
- Lists of all new sites and lost sites during the analysis period, including start/end dates. These are used to accurately track the population over time and to ensure that each new or lost site is only included in calculations for the time period for which it was active.

The provision of this data allows the consumption for each individual meter point, for each formula year of interest, to be calculated using the method described in Section 6.3. The exact format of the data provided is described in Appendix A.

5.3 IGT CSEP Setup and Registration Delays

Data for iGT CSEP setup and registration delays consists of two elements, as follows:

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

  This data is supplied by Xoserve in two-monthly snapshot files on an ongoing basis.
- **Known CSEP Data**

  This file contains data for both registered sites on known CSEPs and unregistered sites on known CSEPs. It is supplied on an annual basis.

5.4 Unregistered/Shipperless Sites

The following information is supplied by Xoserve concerning Unregistered/Shipperless sites. For all aggregate-level data both the number of sites and their aggregate AQ is included. All data is split by LDZ, and also between SSP and LSP market sectors.

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 is listed as having been removed and 12 months later the gas transporter visits the site to remove or make the service secure (the GSR visit), but finds a meter connected to the service and capable of flowing gas. If it is the same meter as supposedly removed 12 months previously it is passed to the Shipper concerned to resolve.

- **Shipperless Sites SSrP (Shipper Specific rePort)**

  Similar to Shipperless (Passed to Shipper) sites, these are sites where the GSR visit finds a new meter fitted and capable of flowing gas, 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. At this point they will move to either the Shipper Activity or the Orphaned category.

All of this data is supplied by Xoserve in two-monthly snapshot files on an ongoing basis.

In addition, the following information is supplied on an annual basis:

- A summary of the remaining Shipperless sites, i.e. those that have been recorded as Isolated for less than 12 months and are awaiting their GSR visit. These sites do not yet appear in the Shipperless PTS or Shipperless SSP lists because sites only qualify for these after the GSR visit has found a meter at the site. This data comes from GSR visit records.
- Connection details for Orphaned sites, including asset and Shipper meter reads and information on whether the confirming Shipper is the same as the Shipper whose Supplier requested asset installation. This data is used to determine the proportion of sites that have been flowing gas prior to becoming registered and the proportion of these that can be back-billed.
- Shipperless Sites supporting data. This is used to ascertain the final outcome for each Shipperless site that has appeared in any snapshot but has subsequently been either disconnected or (re)confirmed. This is used to determine whether the UG arising from them is temporary or permanent under the terms of Mods 0424 and 0425.

Updated data for all of these items has been requested.

5.5 Meter Errors

Data for meter error calculations consists of meter capacity, AQ and NDM/DM classification records for all LSP sites. This report is supplied on an annual basis, with the latest one having been received by the AUGE in July 2013. An update of this file has been requested for the 2014 UG analysis.

5.6 Theft

Data for detected and alleged thefts from 2008 to end March 2014. An update to this data has been requested, to include the month reported and market sector.

6 METHODOLOGY

This section describes in detail the methodology for each aspect of UG. Full details have been included here for completeness to provide a definitive self-contained description of the latest version of the method.

The Consumption Method can be stated in its simplest form as:

Total UG = NDM Allocation - Metered NDM Consumption

This involves correcting the allocations to take account of meter errors (LDZ offtake and DM) and calculating the metered consumption using meter reads / metered volumes (or an EUC average consumption for sites where no reliable metered data is available).

The Total UG calculated as above includes both permanent and temporary Unidentified Gas. Therefore temporary UG (calculated from the individual component parts of UG) has to be subtracted from the initial UG total, and it is this amended figure that then goes forward into the remainder of the calculations.

6.1 DM LSP Market Sector

In the 2011 AUGS for 2012/13 [10], the UG attributed to DM LSP sites was concluded to be negligible. This was based on the following assumptions:

- There is no theft from DM sites.
- Any Unregistered DM sites are backbilled.
- DM sites do not become Shipperless.
- There are no unknown DM sites.
- There is little or no over-read on DM sites due to meters working at the very low end of their range.

In addition, it is known that DM sites on unknown CSEPs will be backbilled because this applies to all LSP sites on CSEPs.

Additional data is now available that allows these areas to be addressed more closely. An analysis of DM UG from all sources has therefore been carried out, and the following conclusions were drawn:

- Shipperless Sites
  There are no Shipperless PTS DM sites (either DM voluntary or DM mandatory). In the Shipperless SSrP market sector, out of over 80,000 records there is one DM site that is long-term Shipperless and is contributing to UG. The UG from this site will be assigned to the DM sector manually (and hence removed from NDM LSP) at the end of the Shipperless UG calculation process. The energy value associated with this site will take a maximum value of approximately 4 GWh.

- Unregistered Sites
  A small number of Unregistered sites that went on to have confirmed AQs above the mandatory DM threshold are known to exist. These specific sites have been queried with Xoserve with regard to whether they flowed gas whilst Unregistered, and if they did, whether they were billed for it. A larger number of additional sites have requested AQs above the mandatory DM threshold (but below the VLDMC threshold), and in the absence of further data we must also regard these as DM sites. The current assumption (pending verification from Xoserve as described above) is that these

sites will be backbilled if they flow gas whilst Unregistered, and hence they affect the permanent/temporary split in this category. The method for dealing with this is detailed in Section 6.4 below.

- iGT CSEPs
  As described above, LSPs in CSEPs are always backbilled and hence contribute temporary UG only. Therefore in this case the DM/NDM split of the LSP sector is not important and the current method is sufficient.

- Consumer Meter Errors
  The DM component of this UG category was not included in last year's figures due to its low magnitude compared to the level of uncertainty in the data. It remains a potential source of UG, however, and the method of calculating it for inclusion in the UG estimates is described in Section 6.6 below. As with previous years, this DM UG component will only apply if the magnitude justifies it. This decision is dependent on data from Xoserve that is yet to be supplied.

- Theft
  It has been confirmed that out of nearly 6,000 theft records from 2008 onwards, none are from DM sites. Therefore, given that detection of theft is more likely for a DM site due to the greater scrutiny upon it, it is reasonable to assume that there is no theft from this market sector.

- Open Bypass Valves
  Xoserve have confirmed their belief that if bypass valves are left open on DM sites, they are discovered and backbilled at some stage, i.e. there are no bypass valves in the DM sector left open indefinitely. If evidence is supplied that this is not the case it will be considered by the AUGE, but in the meantime this assumption will remain in place.

- Unknown Sites
  As stated above, it is currently assumed that there are no unknown DM sites. The Mod 431 analysis that will be undertaken by Xoserve will provide an opportunity to validate this assumption, using data on Found Sites that will be supplied to the AUGE on completion. It is currently unknown whether this analysis will be complete in time for inclusion of any such results in the UG estimates for 2015/16. If any previously-unknown DM sites are found, these will be taken account of when calculating the UG figures for historic years (i.e. the training years used to estimate the Balancing Factor). Consumption from such sites will be deducted from the total allocation used in the UG calculation (i.e. the figure from which metered consumption is subtracted to leave total UG). This will result in a drop in the magnitude of the Balancing Factor, and this lower value for the Balancing Factor will be taken forward to the forecast year.

6.2 Correcting the NDM Allocation

The NDM allocation is calculated as

$$Alloc_{NDM} = Aggregate\ LDZ\ Load - DM\ Load - Shrinkage$$

Any subsequently detected significant errors in these three components will constitute temporary UG which has since been reconciled. Therefore we correct the allocations to remove this element.

6.2.1 Known DM and LDZ Metering Errors

Meter error adjustment data is received on an LDZ by LDZ basis split by billing month. The total value of the error is given, and this is split into 6-month periods so that the correct proportion of each meter error can be assigned to each formula year in which the error is active.

These errors affect the Aggregate LDZ Load and the DM Load, and have opposite effects on the allocation total, which is calculated at the formula year level of granularity. The result of applying corrections for the meter errors is as follows:

- LDZ meter under-reads *increase* the total NDM allocation
- LDZ meter over-reads *decrease* the total NDM allocation
- DM/Unique site meter under-reads *decrease* the total NDM allocation
- DM/Unique site meter over-reads *increase* the total NDM allocation

6.2.2 Shrinkage Error

Shrinkage Error is not a component of UG, and hence no attempt is made to estimate it directly. Any residual effects of Shrinkage on the UG estimate (such as long-term bias in the Shrinkage models), should they exist, are automatically included in the UG calculation via the Balancing Factor.

Full details of the AUGE's assessment of Shrinkage can be found in Section 6.4 of the 2011 AUGS for 2012/13 [10].

6.3 NDM Consumption Calculation

The consumption algorithm relies on a large quantity of data, summarised in Section 5.2. A full description of the raw data used to calculate consumption figures for each individual meter point is described in Appendix A. This raw data is then pre-processed to validate it and to derive additional information to help speed up the consumption calculation process. After the pre-processing the main algorithm is run to calculate consumption on a meter by meter basis. This calculation will not be successful in all cases so a final step is required to scale up the consumption estimate to account for these 'failed' sites.

6.3.1 Data Pre-Processing

In order to calculate the total UG figure it is useful to pre-process the raw data in order to validate it and derive some additional data fields. All data fields used by the consumption method are described in Appendix B along with the methods used to derive those fields from the raw data.

6.3.2 Algorithm

Figure 12 shows a flow chart of the process involved to calculate the consumption for a single meter and formula year with references to numbered steps, which are described in detail below. In addition to this description, worked examples of both a standard consumption calculation and a meter index roll-over affected calculation are given in Appendix C.

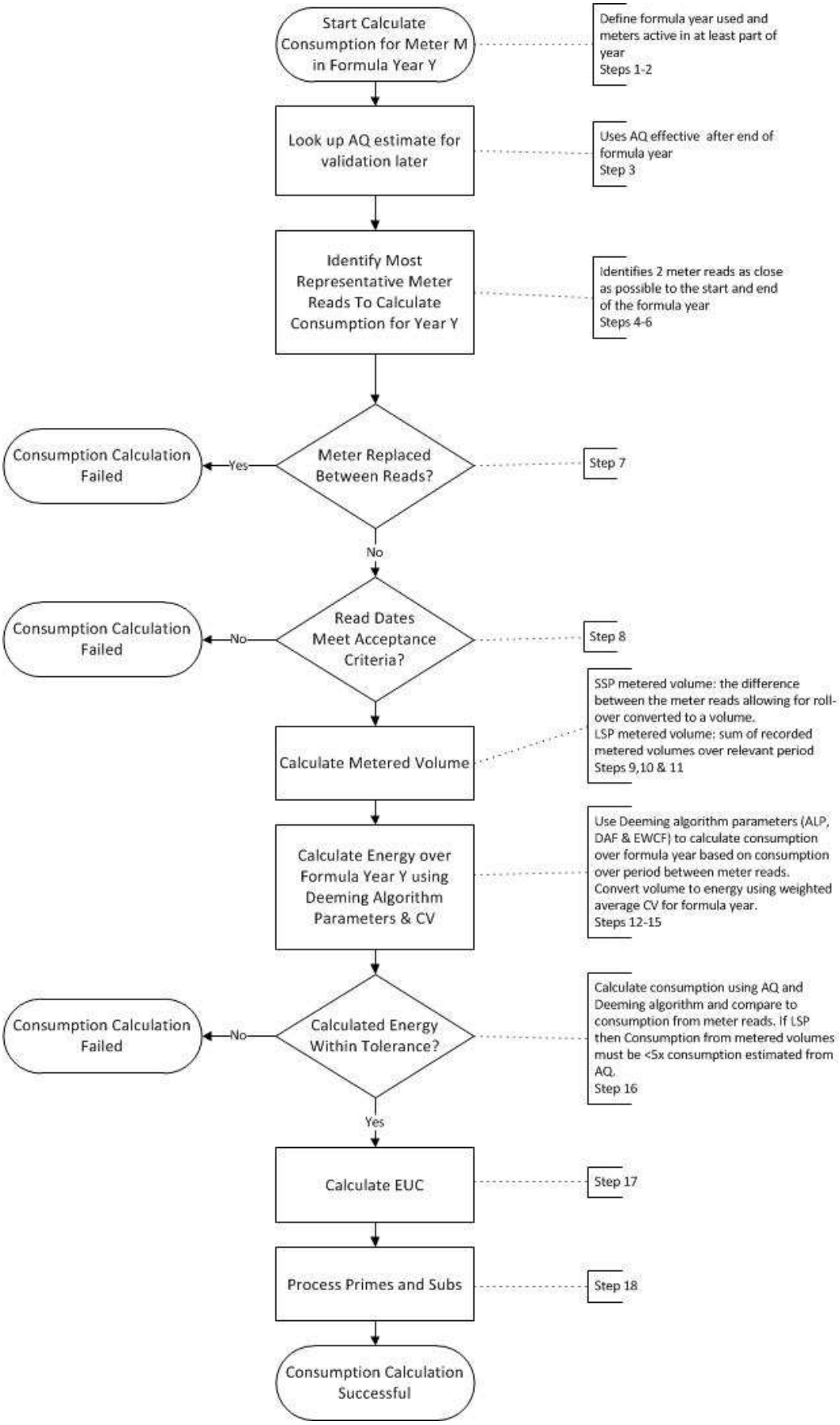

Figure 12: Consumption Algorithm Flow Chart

1. Given a formula year Y, define the start and end dates as 01 Apr YY and 31 Mar YY+1
2. Find all meter points that were active and NDM in a least part of year Y.
3. Look up the first AQ estimate effective after the end of the formula year. If none exists after the end of the formula year use the latest value. From this record store
   i. The AQ value
   ii. The EUC provided by Xoserve
   iii. The pre-calculated consumption band derived by the AUGE from the AQ value.
   iv. Market sector (SSP/LSP) based on the EUC from Xoserve
4. For each meter point find the meter reading date and value for:
   - LB1 (Lower Bound 1) – the latest meter reading prior to the start of the formula year
   - LB2 (Lower Bound 2) – the earliest meter reading within the formula year
   - UB1 (Upper Bound 1) – the latest meter reading within the formula year
   - UB2 (Upper Bound 2) – the earliest meter reading after the end of the formula year

   For SSPs we exclude those readings which have been flagged as bad by the pre-processing.

   Where a meter point has changed between NDM and DM or vice versa we try to select meter reads from the period when it was NDM.

   Note that for any given meter point, only a subset of this full set of reads may be available. We need at least one lower bound and one different upper bound meter read. Possible scenarios are shown in Figure 13 below:

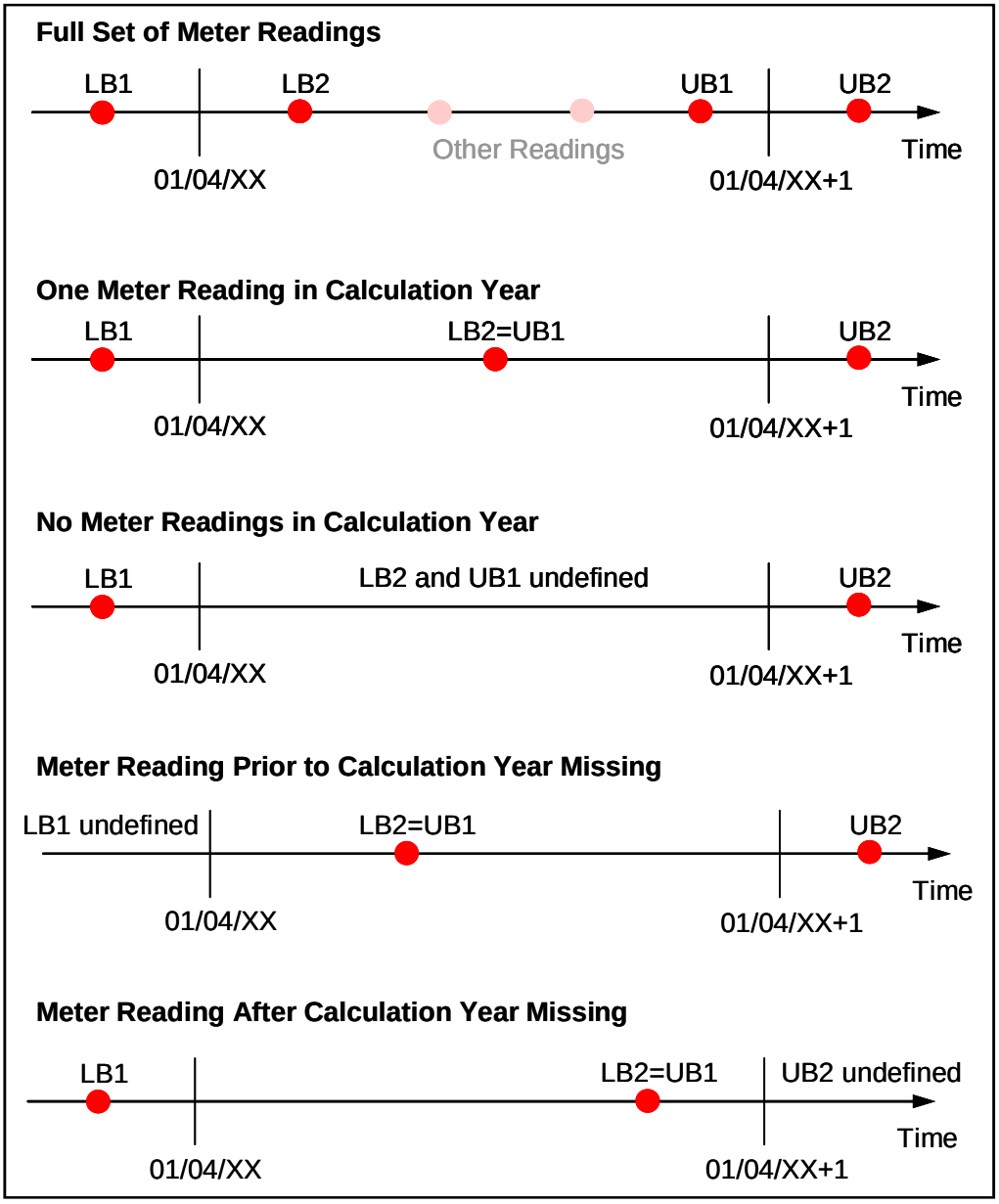

Figure 13: Meter Read Availability Scenarios

5. Set the start meter read date to LB1 unless
   A. the date of LB1 is more than 540 days from the start of the formula year, or
   B. the meter was replaced on or after LB1 and before LB2

   In which case set it equal to LB2.

6. Set the end meter read date to UB2 unless
   A. the date of UB2 is more than 540 days from the end of the formula year, or
   B. the meter was replaced after UB1 and on or before UB2

   In which case set it equal to UB1.

7. If the meter was replaced between LB2 and UB1 inclusive, then reject the meter point.

8. Check that:
    A. The distance between the two chosen meter readings is at least 120 days
    B. The overlap between the metering period and the formula year is at least 60 days

    If this is true then proceed to calculating the metered volume, otherwise reject the meter point.

9. Apply either Rule A or Rule B according to the market sector of the meter point:
    A. If the site is SSP then calculate the volume consumed between the two chosen meter readings (mr_1, mr_2). If this gives a negative volume then check if the meter index has rolled over (see subsection below).
    B. Otherwise sum the metered volumes (mv_i) and volume corrections between the two chosen meter readings. If there are any negative volumes in the range, set the sum to -1.

    If this step produces a positive volume then proceed to the next step, otherwise reject the meter point.

10. Calculate the fraction of the year that the meter point was active and NDM weighted by the WAALPs.

11. Calculate the volume taken over the formula year (or fraction of year calculated in the previous step) by multiplying the volume from Step 9 by

$$\frac{\sum_{\substack{Formula\,Year \\ or\,Part\,Thereof}} WAALP^V}{\sum_{\substack{Metered \\ Period}} WAALP^V}$$

    where $WAALP^V$ is the WAALP divided by the relevant CV value (i.e. a 'volume' WAALP rather than the usual energy WAALP).

12. Look up, in the meter asset information, whether the meter is/was metric or imperial and then apply either Rule A or Rule B to match the rule chosen in step 9.
    A. If the meter point is SSP look up the read units (U).
        - First choice is the units inferred from the meter read records.
        - If this could not be calculated then use the units provided by Xoserve.
        - In the case where the read units from Xoserve are obviously wrong (i.e. are 0 or not a power of 10) use 1 for metric and 100 for imperial meters.

        Combine this value with the default correction factor (CF) 1.022640 and relevant metric/imperial conversion factor to get a combined conversion factor.
    B. Otherwise, if LSP look up the appropriate metric/imperial factor.

    If no meter asset information can be found, reject the meter point.

13. Calculate the weighted average CV for the formula year, calculated as

$$\frac{\sum_{\substack{Formula\,Year \\ or\,Part\,Thereof}} WAALP}{\sum_{\substack{Formula\,Year \\ or\,Part\,Thereof}} WAALP^V}$$

14. Convert the formula year volume to energy in kWh by multiplying the output of Steps 11, 12 and 13 together. In summary, depending on the market sector of the meter point, this will be

$$Con = (mr_2 - mr_1) * U * CF * CV/3.6\ (* 0.0283168466\ if\ imperial) \text{ for SSP}$$

$$Con = \sum mv_i * CV/3.6\ (* 0.0283168466\ if\ imperial) \text{ for LSP}$$

15. Calculate an AQ from this consumption using the appropriate Cumulative Weather Adjusted Annual Load Profile (CWAALP)

$$AQ = Con * 365 / CWAALP$$

16. If we have calculated a new AQ value from the meter readings that is more than five times larger than the old AQ and the new AQ puts the site in the LSP market then reject the meter point. If the old AQ is 1 then use five times the largest recorded AQ as the check instead.

17. If the consumption calculation was successful, calculate an EUC band based on the new AQ.

18. Carry out post-processing to avoid double counting of subs and deduct consumption. See subsection below for details.

Meter Index Rollover Check

Given two reads mr_1 and mr_2 where (mr_2 - mr_1) < 0 we use the following process:

1. Estimate the number of dials from mr_1

$$num\_dials = max(ceil(log_{10}(mr_1)), 4)$$

2. Determine the maximum possible meter read

$$max\_read = 10^{num\_dials}$$

3. Calculate the period between the two meter reads in years

$$num\_years = \sum_{mr_1(date)+1}^{mr_2(date)} ALP / 365$$

4. Assume meter index roll-over and re-calculate the volume

$$tmp_1 = max\_read - mr_1 + mr_2$$

5. Calculate the new volume as a fraction of the max read per year

$$tmp_2 = (tmp_1 / max\_read) / num\_years$$

6. If tmp_2 < 0.25 then we assume meter index rolled over and use tmp_1. Otherwise we leave the calculated volume as negative and reject the meter point.

Prime and Sub Meter Post Processing

As the prime meter consumption is the difference between the total consumption (based on the prime meter reads) minus the sum of the sub-meter consumptions, issues can arise in cases where a full valid set of consumptions for all meters within a sub-prime configuration are unavailable. Note that the consumption methodology will not calculate consumption for a DM meter. There are four cases to consider:

- If the prime meter is DM, no action is necessary as the methodology won't have calculated consumption for the prime meter (consumption not required for DM meters). Sub-meters will be calculated correctly based on available data.
- If the prime meter is NDM and contains one or more DM sub-meters then the prime meter consumption calculation is flagged as having failed so that an EUC average consumption is used (see 6.3.3).
- If the consumption calculation fails for any of the sub-meters then the prime meter calculation is flagged as having failed. An EUC average consumption is therefore used for the prime meter.
- If the consumption calculation succeeds for the prime meter and all of its sub-meters then the prime meter consumption is calculated by subtracting the sub-meter consumptions from the total prime meter consumption.

6.3.3 Aggregation and Scaling-Up

When applied to each meter point in any given LDZ, the algorithm outputs a set of consumptions that can be aggregated to EUC level. The aggregated data for each EUC is also naturally split into the following categories by the algorithm:

- Meters for which a consumption could be calculated
- Meters for which the algorithm failed (failed to calculate consumption or calculated consumption failed validation)
- Meters in CSEPs (for which meter reads are not available)

The sum of these three categories across all EUCs gives the total NDM population of the LDZ.

Where a consumption value was successfully calculated the EUC is based on this consumption, otherwise it is calculated by the AUGE based on the AQ.

Therefore, for each EUC band we can calculate:

1. The number of meter points with a successfully calculated consumption.
2. The number of meter points for which we do not have a calculated consumption (i.e. failed calculation).
3. The average consumption for those meter points with a calculated consumption greater than zero.

The values for 3) are then used to estimate the consumption for meter points in 2). This involves a number of subtleties:

- In 3) we restrict attention to consuming meters only, in order to account for potential differences in the proportion of non-consuming meters within and outside the sample.
- Meter points where the consumption calculation fails are classified as consuming/non-consuming based on AQ, as this is the only reliable data available for such meters. It is recognised that due to changing circumstances for each meter, those with an AQ of 1 for Year

X are not necessarily non-consuming during Year X. Likewise, those with an AQ greater than 1 for Year X are not necessarily consuming in Year X. Therefore, two figures have been calculated using available information (i.e. meters within the sample):

- the proportion of meters with AQ = 1 for Year X that are consuming in Year X = A
- the proportion of meters with AQ > 1 for Year X that are consuming in Year X = B

- The consumption for the non-calculated meter points is then calculated as

  Consumption = A x (meters with AQ = 1) x "AQ=1" average consumption
  + B x (meters with AQ > 1) x EUC average consumption

  Where:

  - *"AQ=1" average consumption* is the average consumption of meter points where the AQ=1, but our consumption estimate is greater than zero. This can arise when an AQ review produces AQ=1 yet the period of consumption being validated is actually non-zero.
  - *EUC average consumption* is the average consumption for successfully calculated meters in the corresponding EUC Band. The 01B EUC average excludes meters where AQ=1.

- CSEPs are treated differently to failed meters. This is because meter points are assigned to EUC band based on their maximum potential AQ which may not be the same as their current AQ. It is not appropriate to estimate their consumption using the number of meter points in each EUC band multiplied by the EUC band average consumption. For 2014/15, the aggregate current AQ was used as the best available estimate of CSEP consumption. Following more detailed analysis during 2014, a new more rigorous approach based on AQ is used, as described in Section 6.3.3.1.
- Where the sample size for a particular EUC for a given LDZ and formula year is less than 30 the national average is used in place of the LDZ average.
- Failed meter points which were only active for part of the year are assigned an average demand scaled based on the sum of WAALPs for that part of the year.

Figure 14 below summarises the process for obtaining a consumption value for each type of meter point.

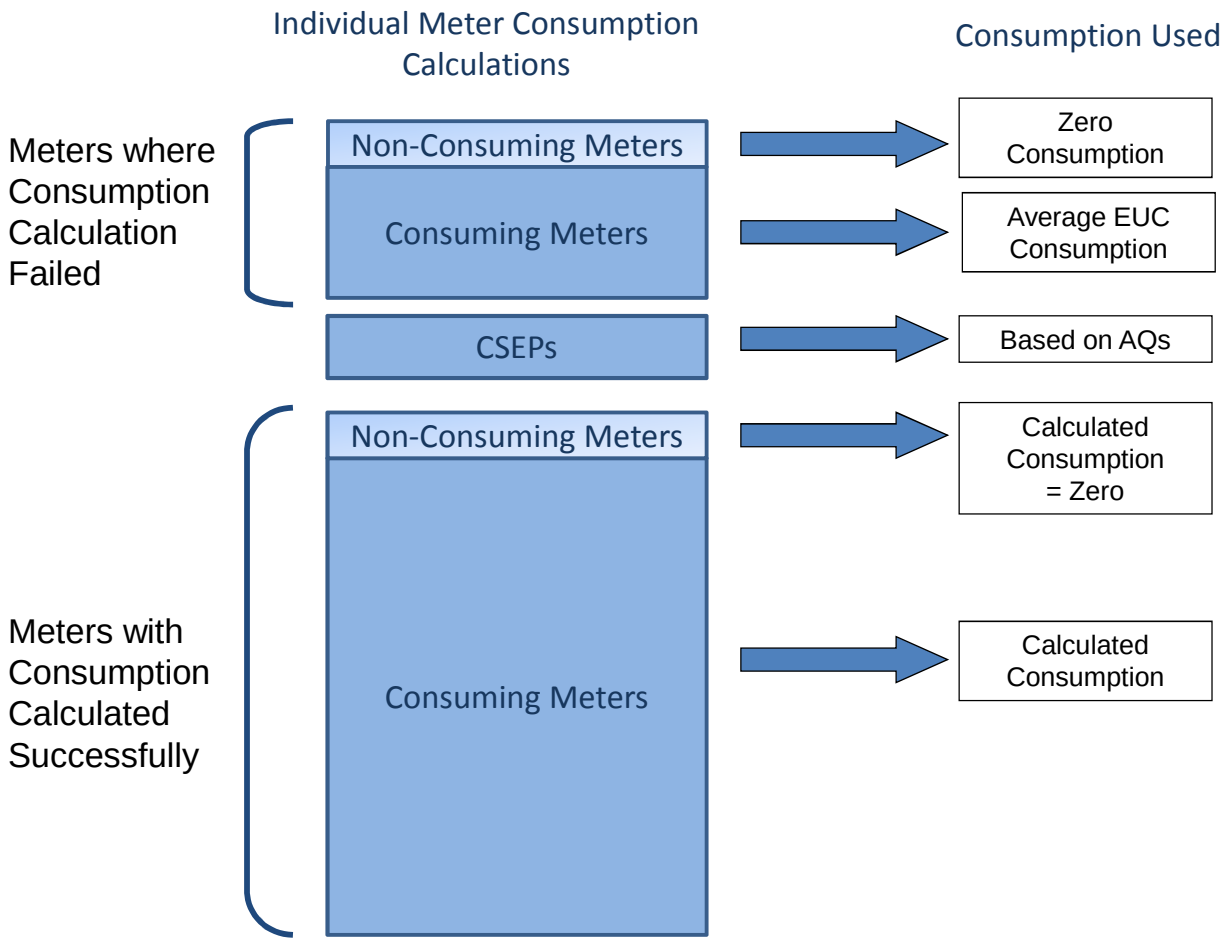

Figure 14: Consumption Method used for each type of Meter Point

UG for the LDZ for the formula year in question is then calculated by summing the metered NDM consumptions across all EUCs and subtracting these from the total combined allocations for the same period.

It is important to note that at this stage these figures still include temporary UG. Therefore, whilst giving an indication of the order of magnitude of the permanent UG total for that historic year, this is simply a step in the calculation process and not an estimate of the final value. The method for calculating the remaining temporary elements is defined in detail in the relevant subsections below.

6.3.3.1 CSEP Consumption Calculation

The following steps are used in the calculation of CSEP consumption for formula year Y. The steps are carried out separately for each LDZ and EUC. All references to AQ mean the CSEP AQ for the corresponding LDZ and EUC unless stated otherwise.

1. If the number of meter points in the CSEP is less than 100 in year Y then the CSEP consumption estimate for year Y is the aggregate AQ for year Y

$$C_Y = AQ_Y$$

   Otherwise,

2. Calculate the average AQ for new meters

For EUC01B,

$$NMAQ = AQ_{2007} / N_{2007}$$

For all other EUCs,

$$NMAQ = AQ_{Y+1} / N_{Y+1}$$

3. Calculate the average AQ for lost meters

$$LMAQ = AQ_Y / N_Y$$

4. Estimate the aggregate AQ for year Y by adjusting Y+1 for meter changes

$$AQ'_Y = AQ_{Y+1} - Max(0, (N_{Y+1} - N_Y) * NMAQ) - Min(0, (N_{Y+1} - N_Y) * LMAQ)$$

5. Adjust the aggregate AQ to allow for the recalculation success rate

$$AQ''_Y = AQ_Y + (AQ'_Y - AQ_Y) / RR$$

Where

AQ_Y is aggregate AQ in year Y. Note that for 2009, AQ_Y is adjusted to the new SNCWV definition.

AQ'_Y is the aggregate AQ in year Y+1 adjusted to allow for the different number of meters to year Y (as in step 4 above)

RR is the recalculation success rate expressed as a fraction

6. Estimate consumption for year Y by adding effect of new/lost meters

$$C_Y = AQ''_Y + Max(0, (N_{Y+1} - N_Y) * MAQ_{Y+1}) / YFrac + Min(0, (N_{Y+1} - N_Y) * MAQ_Y) / (1-YFrac)$$

Where

C_Y is the final estimate of aggregate CSEP consumption for year Y

AQ''_Y is the estimate of aggregate AQ for year Y calculated from year Y+1 and adjusted for the recalculation success rate

N_Y is the number of meters in year Y

MAQ_Y is the average AQ per meter in year Y and is calculated as AQ_Y / N_Y

YFrac is an estimate of the proportion of a year's consumption which new meters contribute. It is assumed that new and lost meters will be consuming on average for half of the year. However, new meters are more likely to be consuming over the winter period whilst lost meters are more likely to be consuming over the summer period. A value of 0.75 is used for YFRAC as winter consumption is assumed to be approximately double the summer consumption.

If this estimate is negative then use the AQ as the best estimate of consumption i.e. $C_Y = AQ_Y$.

6.4 Unregistered and Shipperless Sites

The analysis for this element of UG has been updated for the current year due to the implementation of Mod 0410A and Mod 0425. For completeness, a full description of the calculation method, including the new elements, is given.

Raw data for all categories of Shipperless/Unregistered UG except "Without a Shipper <12 Months" is contained in snapshot files supplied by Xoserve every two months. In addition to the summarised data in these files, details of each individual MPRN that contributes to the summary data are also supplied.

The following files contain data that is also used in the calculation process and are supplied on an annual basis.

- **Connection Details for Orphaned Sites**
  This dataset includes asset and Shipper meter reads and information on whether the confirming Shipper is the same as the asset Shipper. This data is used to determine the proportion of sites that have been flowing gas prior to becoming registered and the proportion of these that can be back-billed. Backbilling can only occur if the confirming Shipper is the same as the Shipper that carried out site works for MPRNs created before this date. The AUGE splits this dataset into two categories (pre-Mod 0410A sites and post-Mod 0410A sites) and calculates different factors for each.

- **Gas Safety Regulations Visit Details**
  The gas safety visit data is used to estimate the number and AQ of sites that have been recorded as Isolated for less than 12 months and hence have not yet had their GSR visit and do not yet appear in the snapshots as Shipperless PTS or Shipperless SSrP, but are nevertheless still consuming Shipperless gas.

- **Shipperless Sites Supporting Data**
  This dataset contains the confirmation date of each Shipperless site that has appeared in any snapshot but has subsequently been (re)confirmed. It is used to ascertain the final outcome for each of the sites, i.e. whether it was (re)confirmed or whether it was disconnected. This is used to determine the proportion of Shipperless sites that have a meter and are *capable* of flowing gas that actually *are* flowing gas.

Further details of these data files are given in Section 5.4 above.

A flowchart of the calculation process for Shipperless and Unregistered UG is shown in Figure 15. A step-by-step procedure for the calculation of the UG estimates follows.

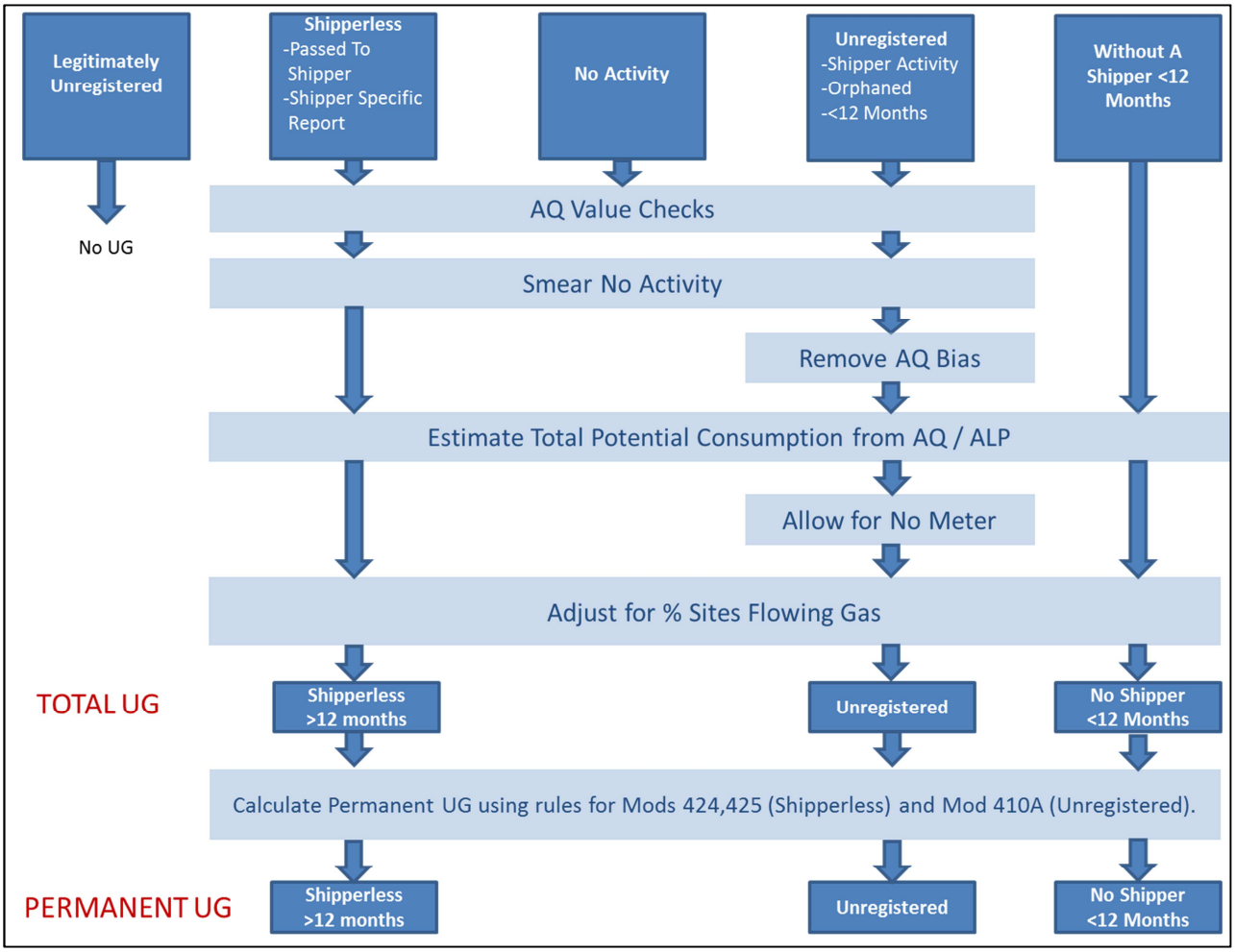

Figure 15: Shipperless and Unregistered UG Calculation Process

The step by step calculation process for Shipperless and Unregistered UG is as follows:

1. In the backup files containing data for each individual MPRN, each MPRN is assessed and flagged for further investigation by Xoserve if any of the conditions specified below are satisfied.
    - If a graph of AQs sorted by descending magnitude contains a "shoulder" point (i.e. a distinct change in gradient), any points to the left of the shoulder are flagged.
    - Any site with an AQ more than 100 times the average LSP AQ is flagged.
    - Any DM site (i.e. with an AQ greater than 58.6 GWh) is flagged.

    The resultant list of flagged sites is sent to Xoserve.

2. Xoserve will respond with details where any of the flagged sites have been confirmed on their system, and the confirmed AQ of each such site is provided. Any differences between the queried AQs and the confirmed AQs are aggregated to LDZ level for each category of Shipperless or Unregistered site for each snapshot. The data in the relevant snapshot file is then amended to account for these differences. Seven consecutive two-monthly snapshot files are required to calculate the Shipperless and Unregistered UG for a year. Sites where Xoserve have no further information are left as is.

3. All sites with a listed AQ above the VLDMC threshold (1.465 TWh) have their AQs replaced with the average LSP AQ. VLDMCs cannot be Unregistered or Shipperless due to the greater scrutiny the network code requires on such sites, and hence any AQ above this threshold in the Unregistered or Shipperless lists must be erroneous (e.g. MPRN or phone number accidentally entered in AQ field).

4. Before the analysis is run, the following coefficients are also updated if new data is available.

   - Fraction of opening meter reads with gas flow for Unregistered sites (for permanent/temporary split for Unregistered categories, different fractions for pre-01/09/2013 and post-01/09/2013 sites).
   - Fraction of Unregistered UG not backbilled (for permanent/temporary split for Unregistered categories, different fractions for pre-01/09/2013 and post-01/09/2013 sites).
   - Proportion of Shipperless sites being disconnected rather than re-registered.

5. "Fraction of opening meter reads with gas flow" is calculated using the "Connection Details for Orphaned Sites" spreadsheet. This file contains a list of Orphaned meters and includes both their asset meter reading and their opening Shipper meter reading. The number of meters with gas flow (i.e. those where the reading has changed) is expressed as a proportion of the total number of meters in the sample. The dataset is split into two sections - pre-Mod 0410A sites and post-Mod 0410A sites – and separate factors are calculated for each in order to account for changes introduced in the Mod. The calculated proportions are applied to the total AQ of pre-Mod 0410A and post-Mod 0410A sites with meters to give an estimate of the consumption from sites that are actually flowing gas in the Unregistered UG calculations.

6. "Fraction of UG not backbilled" is also calculated using the "Connection Details for Orphaned Sites" spreadsheet. In addition to the meter readings, this file contains a flag that indicates whether the asset Shipper is the same as the confirming Shipper. This flag is used to calculate the proportion of sites with gas flow (as calculated in Step 5 above) that also have a different Shipper. This is the proportion of Unregistered sites that cannot be backbilled and hence contribute permanent UG. As for "Fraction of opening meter reads with gas flow", separate factors are calculated for pre-Mod 0410A and post-Mod 0410A sites.

7. Once the data has been validated and updated where necessary, the first step in the calculation process is to smear the "No Activity" data. The AQ for this category is divided between all other categories in proportion to their relative AQs (except Legitimately Unregistered sites, which do not contribute to UG). The No Activity category plays no further part in calculations because the UG from these sites will be calculated as part of the remaining categories.

8. The proportion of Shipperless sites that are disconnected rather than reconfirmed is calculated using information from the "Shipperless Sites Supporting Data" spreadsheet. Any site that disappears from the Shipperless lists without appearing in the "Confirmed" list in the supporting data has been disconnected and this is used to calculate the proportion that are disconnected rather than being reconfirmed. This figure is used as the best estimate of the proportion of sites capable of flowing gas that actually *are* flowing gas (i.e. it is assumed that if a site is flowing gas it is reconfirmed, and if it is not it is disconnected).

9. The raw Shipperless/Unregistered UG calculations are now carried out. The calculations are carried out using VBA code contained in spreadsheets supplied to Shippers for their perusal as part of the AUGE process. A formula-based version of the calculation is also available where the individual calculation steps can be followed and verified for a single LDZ at a time. For all categories both the total UG (including that which will subsequently be backbilled) and the permanent UG are calculated. The difference between these figures is the temporary UG from each source and this is deducted from the UG total obtained from the consumption algorithm to return the total permanent UG. Before this adjustment is carried out, both total and permanent Shipperless/Unregistered UG figures are modified where necessary as described in Steps 10-16 below.

   The total annual consumption for each category of Shipperless and Unregistered sites is first estimated using AQ data from the snapshot files (amended as described below). To do this, the most recent seven bi-monthly snapshots are used. Seven snapshots are required to cover a full year because each two-month period of consumption is calculated from the average aggregate AQ across two snapshots for any given Shipperless/Unregistered UG category. Each of these averages is then multiplied by a factor based on the sum of the ALP over that two month period, with this factor normalised such that the sum of the factors over the six periods is equal to one. The estimate of total annual consumption is therefore given by

$$Consumption = \sum \left(AQ_m - AQ_{m-2} \right) \times \frac{P_m}{2}$$

   where
   AQ_m = Aggregate AQ from snapshot for month m
   AQ_{m-2} = Aggregate AQ from snapshot for month m-2, i.e. the previous snapshot
   P_m = Normalised Profile Factor for month m calculated as

$$P_m = \frac{\sum ALP_d \left(2\,month\,period \right)}{\sum ALP_d \left(full\,year \right)}$$

   where

   ALP_d = Value of Annual Load Profile for day d

10. Unregistered sites may or may not have a meter fitted. Where no meter is present, it is assumed that consumption will be zero. For meters in the Shipper Activity and Orphaned categories, the snapshot files contain data split into meter points with and without a meter present. Consumption for these categories is therefore calculated as described above only for meter points where a meter is actually known to be present. For the Unregistered <12 Months category, it is not recorded whether a meter is present or not. For these sites it is therefore assumed that the fraction of meter points where a meter is present is the same as that found across the other two Unregistered categories.

11. The UG estimate for each type of Unregistered site is adjusted to account for the proportion of such sites with meters that actually flow gas whilst Unregistered, as described in Step 5 above.

12. For Shipperless sites, the report contains all sites found to be *capable* of flowing gas. From these, the number *actually* flowing gas must be estimated. This is carried out using data in the

"Shipperless Sites Supporting Data" file supplied by Xoserve. This contains the confirmation details of all sites that have appeared in the Shipperless report but have subsequently been confirmed and is used to determine the proportion of sites that were reconfirmed rather than being disconnected. The following assumptions are then made:

- If the site was disconnected it was not flowing gas
- If the site was reconfirmed it was flowing gas

The reconfirmation percentage is therefore applied to the calculated Shipperless UG totals to give the best estimate of the amount of Shipperless UG actually consumed.

13. For each Unregistered category, factors are used to convert from Requested AQ to Confirmed AQ and then from Confirmed AQ to AQ Following Review, as follows:

    Requested AQ → Factor 1 → Confirmed AQ → Factor 2 → AQ Following Review

    The "AQ Following Review" figure is regarded as a reliable indicator of the annual consumption at the site.

14. The UG estimates produced for each Shipperless/Unregistered category are then multiplied by the appropriate combination of these factors. This is carried out as follows:
    - Shipperless sites (PTS, SSrP): no further adjustment for AQ bias
    - Unregistered (Orphaned, Shipper Activity and Unregistered <12 Months): adjust using composite *Factor1(n) x Factor2*, where *n* represents the UG category in question.

15. In order to account for the effects of Mod 0424, the temporary elements of Shipperless PTS Unidentified Gas must be estimated (i.e. the element that comes from sites Isolated after 01/04/2013). The last Shipperless snapshot that can contain new permanent PTS UG (i.e. from sites Isolated before 01/04/2013) is May 2014. After this, all new sites appearing in the snapshot will contribute temporary UG only. Therefore, in order to establish the permanent/temporary split for the 2015/16 formula year, the May 2014 snapshot is used as the starting point.

    At the time the UG calculations are carried out, the May 2014 snapshot will be available and will contain Isolation dates for each MPRN, and so the actual permanent/temporary split for the starting point will be known. From this point on, no new permanent UG enters the category and the decay of the existing permanent element is modelled using the churn in the Shipperless PTS dataset over time – i.e. the proportion of sites from one snapshot that disappear from the dataset (either by having their meter removed or by being reconfirmed) in subsequent snapshots. The trend in churn over a period of N snapshots can be calculated using the backup MPR data supplied by Xoserve for the full snapshot history currently available.

    The statistic of interest in this analysis is the proportion of sites (in terms of number and AQ) that appeared in the Shipperless PTS category in Snapshot X that also appear in Snapshot X+1. This value is calculated over a number of successive snapshots (i.e. from Snapshot X to Snapshot X+N, with the proportion of Snapshot X sites still Shipperless in Snapshot X+N always reported). These figures are used to derive a relationship between N and the proportion of sites from Snapshot X still remaining Shipperless. This relationship is then used to derive the permanent/temporary split of this UG category over time by applying it to the permanent element of the May 2014 snapshot.

The decay in the permanent UG from the May 2014 snapshot is modelled using the churn equation, and the difference between the total UG in each snapshot and the remaining permanent UG from the churn equation applied to the May 2014 snapshot is the temporary UG from this category.

Analysis of the churn statistics shows that there is a steady decrease in the proportion of remaining sites for the first seven snapshots, after which only long-term Shipperless sites remain and the proportion does not decrease any further. This is illustrated for the SSP market sector in Figure 16 below, which shows the actual and fitted values for the proportion of AQ remaining after 9 snapshots.

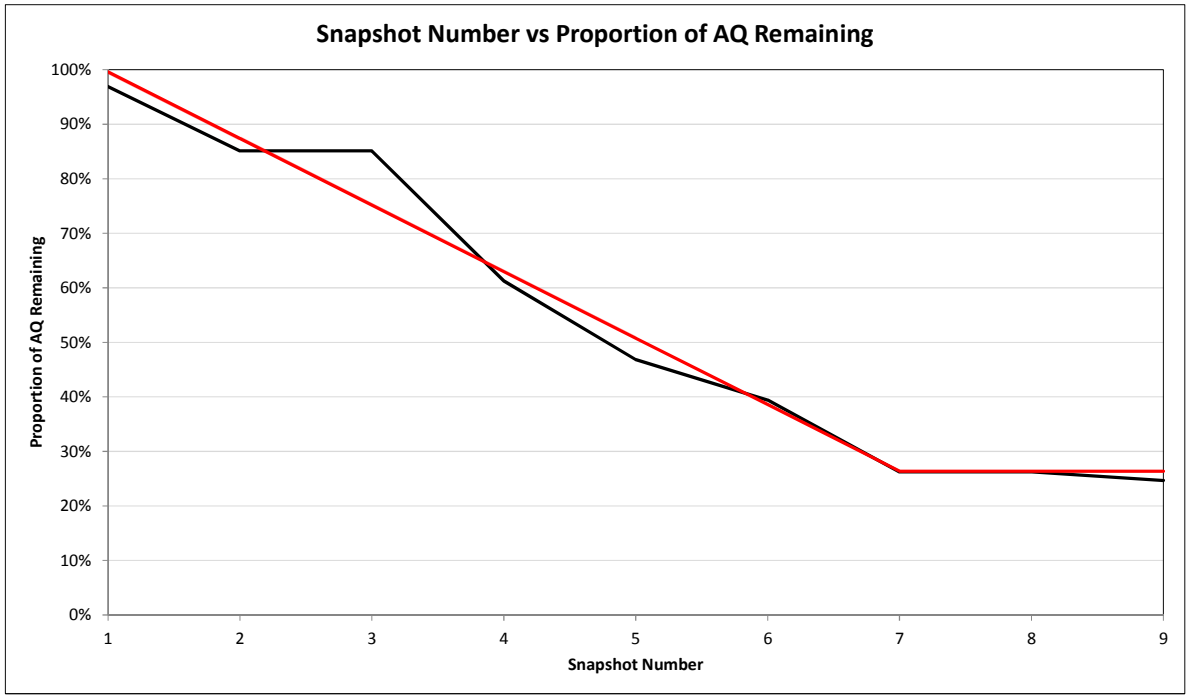

Figure 16: Shipperless PTS Churn

Based on the most recent calculations carried out, the churn equations for SSP and LSP are defined as follows:

Up to and including N=7, the remaining proportion of AQ at Snapshot N is given by the following equations:

SSP: *Proportion = 1.118 – 0.122N*

LSP: *Proportion = 1.045 – 0.104N*

For N>7, N=7 is used in these equations.

In order for these relationships to be accurately implemented taking into account the annual profile in consumption, calculations based on these equations are implemented in the AUGE's Shipperless Contribution Calculator model. For each bi-monthly period of the forecast year, the percentage of the May 2014 permanent UG that remains Shipperless is calculated using the churn equations, and this is multiplied by the normalised annual profile value for the equivalent time period, taken from the ALPs for the relevant market sector. The resultant values are multiplied by the May 2014

permanent UG value, and the final result of this calculation is the permanent Shipperless PTS UG consumed in each period.

Total Shipperless PTS UG is calculated from the snapshots in the usual way. This, as always, involves calculating the UG for the most recent time period for which we have snapshots and assuming that the process remains steady, and this is therefore the best estimate for the UG year being forecasted.

- Permanent UG is subtracted from Total UG (both calculated as defined above), with the remainder being temporary UG.
- Permanent and temporary UG thus calculated are then treated as appropriate in the overall UG calculations.

16. The effect of Mod 0425 on Shipperless SSrP is modelled in exactly the same way as Mod 0424 for Shipperless PTS. In this case, however, the effective date of the Mod is 01/04/2014 and hence the final snapshot that can contain new permanent Shipperless SSrP sites is May 2015. The contents of this snapshot must therefore be estimated in two stages, as follows:
    - Total size of snapshot (i.e. temporary plus permanent)
    - Temporary element

    The total snapshot size is estimated very simply by using the equivalent snapshot from the previous year (i.e. the May 2014 snapshot, which will be available at the time the calculations are being made). The temporary element is modelled using a similar technique to the churn equations for decay, but operating in the opposite direction. In this case a base date is chosen and the proportion of each subsequent snapshot that comes from MPRNs Isolated after the base date is calculated. These equations (one per market sector) are used to extrapolate from 01/04/2014 – the effective date of the Mod, where the Shipperless SSrP category was fully permanent – to the May 2015 snapshot. The most recent version of these "Temporary UG Increase" equations is as follows:

    SSP: $Proportion = 0.0006N^3 - 0.0037\ N^2 + 0.0102N - 0.0060$

    LSP: $Proportion = 0.0014N^3 - 0.0138\ N^2 + 0.0417N - 0.0299$

    Once the start point (May 2015) has been defined using this method, the churn procedure defined in Step 16 above is applied to model and defines the decline in permanent UG from this source for the forecast year.

17. "Without a Shipper <12 Months" UG is calculated using Gas Safety Regulations visit data supplied by Xoserve. This file contains the details of each Shipperless site that has crossed the 12-month threshold during a period of a year and has subsequently been visited and found to be capable of flowing gas. The actual sites listed in this file by definition appear in the summarised data in the snapshot files because they have been Shipperless for more than 12 months. If it is assumed that sites become Shipperless at a steady rate, however, it can be assumed that the number and AQ of sites crossing the 12-month threshold in Year Y is a good approximation of the number and AQ that will cross in Year Y+1. At the end of Year Y these sites will have been (recorded as) Isolated

for less than 12 months and hence make up the "Without a Shipper <12 Months" UG category for this year.

Therefore, in order to estimate the UG from this category, the AQs from the GSR visit data are aggregated by LDZ and SSP/LSP split. Given that the sites in question will have been becoming Shipperless at a steady rate throughout the year, they will on average have been (recorded as) Isolated for 6 months each. Therefore each aggregate AQ total is divided by 2. Finally, the reconfirmation percentage (as described in Step 12 above) is applied to convert from the AQ of sites *capable* of flowing gas to the AQ of sites *actually* flowing gas. This gives the final total UG estimate for this category. This figure is then split into PTS and SSrP components using factors based on the relative size of these UG categories. Different factors are used for each market sector.

All sites that fall into the "Without a Shipper <12 Months" category will end up either as Shipperless PTS or Shipperless SSrP if they remain Shipperless for more than a year. In the case of the Shipperless PTS element, all sites making up this category for 2015/16 must be contributing temporary UG only because in order for them to still be awaiting their GSR visit during this year they must have been (recorded as) Isolated after 01/04/2013. For the Shipperless SSrP element, any site without a record of the installation date of the new meter will contribute permanent UG until its GSR visit regardless of the Isolation date. It is assumed that new meters are installed at a steady rate for these sites and as such the average period of the year for which a meter was present and capable of flowing gas is 6 months (i.e. 50% of the year). The following calculation steps are applied:

- For each market sector, multiply the Shipperless SSrP element by the "% of Year with Meter" factor. This gives the total (permanent plus temporary) UG for the Shipperless SSrP elelement of "Without a Shipper <12 Months".
- For each market sector, multiply the total UG by the "% of Meters without Install Date" factor. This gives the permanent element of the UG total. The remainder of the UG for the Shipperless SSrP element of "Without a Shipper <12 Months" is temporary.

18. Mod 0410A affects all categories of Unregistered sites (Shipper Activity, Orphaned and Unregistered <12 Months). At the time of writing, the final form of the models that will be applied to these categories cannot yet be defined due to there being insufficient data to accurately predict their behaviour during the forecast year. Therefore two different options – Method A and Method B – are presented here, and for each Unregistered category a decision between them will be taken when additional post-01/09/2013 snapshots are available. There are a number of areas common to both methods, however, and these are described below before the two alternative options are given.

    MPRNs will be split into two categories for each Unregistered UG category. These are:

    - Created before 01/09/2013
    - Created on or after 01/09/2013

    For Unregistered <12 Months, UG calculations for the post-Mod 0410A set are carried out using the standard technique described above, with the temporary/permanent split determined using the proportion of sites that flow gas whilst Unregistered and cannot be backbilled (calculated as

described in Steps 5 and 6 above). For the pre-Mod 0410A set, UG from this source for the 2015/16 formula year is zero.

Mod 0410A may leave the overall magnitude of Unregistered <12 Months UG unchanged (but make more of that UG temporary), or it may result in a step change down or a downward trend in the total. When sufficient post-Mod 0410A snapshots exist to accurately identify this effect an analysis will be carried out and the appropriate extrapolation technique (i.e. training average, recent training snapshots or trend) will be applied to create the forecast year UG total estimates.

For Shipper Activity and Orphaned sites, a choice between Method A and Method B applies.

Method A

This method will apply if analysis shows that Mod 0410A is effective in its aims of resolving all Unregistered sites by the time they have been Unregistered for 12 months. If this is the case then no new sites will enter Shipper Activity or Orphaned, and these will therefore consist only of decreasing numbers of legacy sites. The UG from this source will then be modelled using the same "decay" technique used for Mod 0424 and Mod 0425. This applies to the pre-Mod 0410A set only, because by definition no post-Mod 0410A sites will enter these UG categories. The decay curve defines the total UG from this source, which is then split between temporary and permanent using the factors described in Steps 5 and 6 above.

Method B

This method will apply if analysis shows that Mod 0410A has not been effective in its aims of resolving all Unregistered sites by the time they have been Unregistered for 12 months, and therefore new sites (created after 01/09/2013 and hence subject to Mod 0410A) are still entering Shipper Activity and Orphaned. If this is the case, the two elements of Shipper Activity and Orphaned – pre-Mod 0410A and post-Mod 0410A – must be modelled separately. The method for pre-Mod 0410A remains the same as in Method A. For the post-Mod 0410A category, it is first necessary to model the total UG for each UG category, using the standard techniques described above. The results of this are extrapolated to the forecast year using the most appropriate method (current level/step change/trend), and the post-Mod 0410A element for the forecast year is calculated as the difference between the total and the pre-Mod 0410A element. These two sub-populations must be modelled separately because different factors that lead to the final estimates of consumption not backbilled must be applied as described in Steps 5 and 6. The relevant factors are applied to the pre-Mod 0410A and post-Mod 0410A elements to give the final permanent/temporary split for this UG category.

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 consuming gas in an unrecorded manner.

6.5.1 Overview

UG from CSEPs arises from two sources: Unknown Projects and Unregistered sites on known CSEPs.

Unknown Projects are CSEPs that are known to exist but for various reasons are not on Xoserve's systems. Regular meetings are held between the iGTs and Xoserve in order to resolve these issues and reduce the number of Unknown Projects.

Unregistered sites on known CSEPs lie in CSEPs that are on Xoserve systems, and Xoserve are notified of such Unregistered sites on them.

For both these sources of UG from CSEPs, that from LSP sites is backbilled and is hence **temporary**. UG from SSP sites on CSEPs is not backbilled and is hence **permanent**.

It is necessary to calculate both the permanent and temporary elements of iGT CSEPs UG so that the raw UG total calculated using the Consumption Method can be reduced to account for the temporary element, leaving the final total as permanent UG only.

6.5.2 Data

Unknown Projects data is supplied by Xoserve in bi-monthly snapshot files. These contain data for all Unknown Projects, split by LDZ and by the year in which the CSEP first came to the attention of Xoserve. For each LDZ, the total number of projects, the total number of supply points within them, and the sum of their AQ is given. Note that no split between market sectors is given.

Unregistered sites on known CSEPs data is supplied in a file provided on an annual basis. This file contains data for all known CSEPs, summarised to the LDZ and EUC level. For each EUC, the count of supply points within CSEPs and their aggregate AQ is given. This is provided in separate tables for registered sites and Unregistered sites.

- Data for registered sites is used to calculate the average SSP/LSP CSEP throughput percentages for each LDZ, and this is used to split the Unknown Projects data by market sector.
- Data for Unregistered sites is used to directly calculate the UG from this source for each LDZ.

It should be noted that the supply point count data for Unregistered sites is actually the number of times Xoserve have been notified that the supply point is Unregistered rather than the number of sites that are actually Unregistered. Xoserve are often notified about the same site on multiple occasions, and this artificially inflates the supply point count figures in this dataset. Therefore further analysis is carried out on this data in order to estimate the actual number of Unregistered supply points. This is described in more detail below.

6.5.3 Process

Processing is carried out in spreadsheets, which are supplied to the industry to allow auditing of the AUGE's calculations to take place. The following process steps are performed:

1. Data for *registered sites on known CSEPs* and *Unregistered sites on known CSEPs* is imported into the calculation spreadsheets. The average AQ per site for each LDZ/EUC combination for registered sites is calculated. As noted above, for the Unregistered data the number of notifications is recorded rather than the number of sites, and hence the actual number of sites must be estimated.

2. The average AQ per site derived from the registered sites is used to estimate the number of Unregistered sites in each EUC using the aggregate AQ for each EUC in the Unregistered dataset.

This gives an estimated number of Unregistered sites in each EUC under the assumption that each site has the average AQ for that EUC.

- If this calculated figure is lower than the number of notifications, it is used as the best estimate of the number of Unregistered sites in that EUC.
- If the number of notifications is lower, this is used as the best estimate of the number of Unregistered sites in that EUC.

3. The total site count and aggregate AQ by market sector (SSP/LSP) and by LDZ is calculated for registered sites. These figures are then used to calculate the percentage split of CSEP site count by market sector and the percentage split of CSEP AQ by market sector. This split is used in the calculations for Unknown Projects, described below.

4. The total site count and AQ by market sector (SSP/LSP) and by LDZ is calculated for Unregistered sites. The AQ figures produced are used directly in the UG figures: these represent the estimated annual contribution to UG from Unregistered sites in known CSEPs based on current conditions.

5. When each new monthly snapshot file becomes available, data for Unknown Projects is updated. The snapshot tables are in the format shown in Table 4 below. In these tables, the "Year" field refers to the year in which the CSEP came to the attention of Xoserve. For each LDZ the total number of Unknown Projects, their aggregate AQ and the total number of supply points within them is given. Each snapshot represents the situation at the point in time when it was produced.

Table 4: Unknown Projects Snapshot

Year	LDZ	Count of Unknown Projects	Sum Of AQ (kWh)	Count of Supply Points
2012	EA	39	4,606,764	361
2012	EM	40	9,717,609	609
2012	NE	4	680,926	27
2012	NO	6	1,981,423	27
2012	NT	50	8,082,751	673
2012	NW	33	3,610,353	251
2012	SC	16	24,549,597	131
2012	SE	19	3,578,899	173
2012	SO	18	1,448,603	114
2012	SW	21	3,912,544	306
2012	WM	37	6,090,727	467
2012	WN	5	2,755,000	31
2012	WS	13	2,482,641	199
	Total	**301**	**73,497,837**	**3,369**

6. The total number and composition of Unknown Projects by LDZ is calculated by summing across all years. The total Unknown Projects supply point count and AQ for each LDZ is split by SSP and LSP market sectors using the percentages calculated from known CSEPs, described in Step 3 above.

7. In some cases there may be additional Unknown Projects where the LDZ is unknown. These are assumed to have average composition by market sector (in terms of supply point count and AQ), with this composition again calculated from registered sites on known CSEPs.

8. The total SSP AQ and LSP AQ across all LDZs plus Unknown LDZ is calculated. These figures represent the best estimate of annual consumption in Unknown Projects at the time the snapshot was produced.

9. The total iGT CSEPs UG is calculated for each LDZ as the sum of Unknown Projects UG for the LDZ (from Step 8 above) and the Unregistered Sites on Known CSEPs UG for the LDZ (from Step 4 above). Any Unknown Projects UG from Unknown LDZ is smeared across all LDZs.

10. The above process gives, for each snapshot, an estimate of what annual UG from iGT CSEPs would be if conditions for the full year remained as they were in the snapshot. The estimates from successive snapshots show any trend that exists, which then requires extrapolation to the year for which UG is being forecast. An example of this trend across a number of snapshots is shown in Figure 17 below.

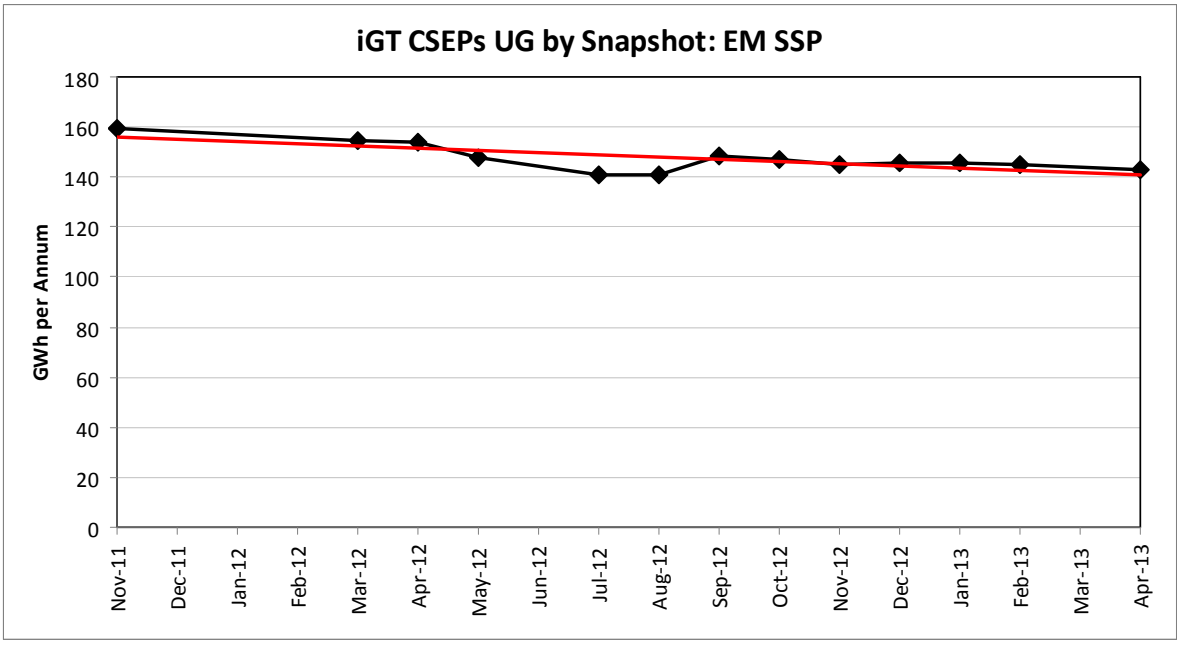

Figure 17: iGT CSEPs UG by Snapshot

11. The identified snapshot-to-snapshot trend for each LDZ/market sector combination is used to extrapolate either forwards or backwards to any time period of interest. The UG for each year used in the analysis is calculated using the (estimated) values from all the snapshot points that fall within it. The time periods in question cover the UG forecast year and the historic UG training years, with values for each calculated using the fitted trend lines for each LDZ. The forecast year table is used for the final UG figures, whilst those for historic years are used in the calculation of total UG and the Balancing Factor, which are based on data from the training years (currently 2009/10 to 2012/13).

12. The UG calculated in this way from LSP sites is **temporary**. The UG calculated in this way from SSP sites is **permanent**. The final figures are therefore carried forward into the overall UG calculations and used as appropriate.

6.6 Consumer Metering Errors

The effects of LDZ metering errors and known DM/Unique Site supply point errors are discussed in Section 6.2 above. In addition, undetected errors in SSP, NDM LSP and DM supply point meters can cause gas to be burnt in an unrecorded or inaccurately recorded manner and hence have the potential to contribute to Unidentified Gas. An assessment of this area of metering error was therefore carried

out by the DNV GL Metering Team as part of the UG analysis for previous years, and the conclusions drawn are presented here:

- 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, which would result in a net bias of zero across each population. In the absence of any evidence to the contrary, this is therefore the assumption made throughout the UG calculations.
- In order for a more detailed analysis of meter drift to be carried out, a large amount of data would have to be collected via a national meter survey similar to that conducted many years ago, as noted in the AUGE's responses to comments on the second draft of the 2012 AUGS for 2013/14 [19]. To carry out such a survey would be a significant undertaking as it would require a random sample of a sufficient size to cover many classes of meter (e.g. age of meter, type, model, level of consumption, capacity etc.), as well as co-operation of the customers and the physical testing of the meter itself with properly calibrated equipment. If such a survey was commissioned and carried out, the results could be used in future analyses of meter error. In the meantime, however, the evidence available leads to the assumption of a net zero drift over the population being used.
- 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 an ad-hoc adjustment are found, these affect the UG calculations directly as described in Section 6.2.1. Data regarding such adjustments is supplied to the AUGE by Xoserve on a regular basis and is used to adjust the initial UG estimates.
- Calibration curves for both diaphragm and rotary/turbine meters follow a similar pattern. Such a curve for a NDM LSP Rotary Positive Displacement (RPD) meter is shown in Figure 18 below.

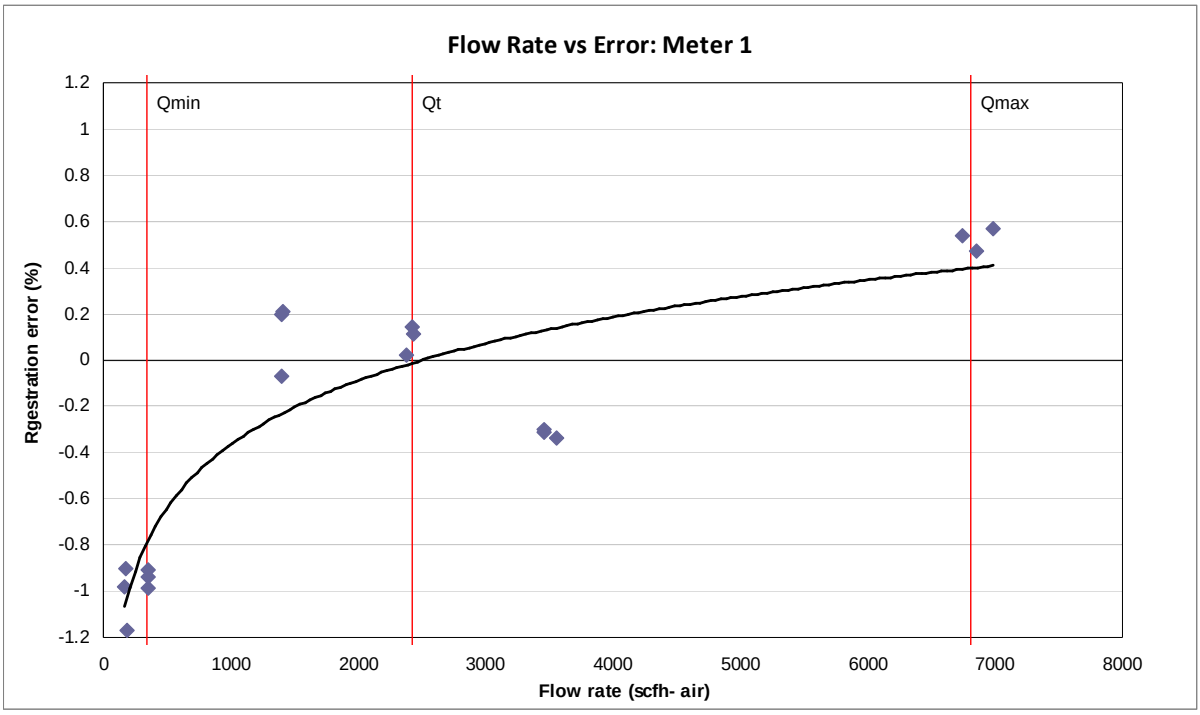

Figure 18: Typical Calibration Curve for an RPD Meter

Data for this graph was provided by the DNV GL 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 lead 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 is limited to the meter capacity and AQ of each LSP site, and this requires the AQ to be used to estimate average hourly load, which can 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 are considered to be likely to be operating at or around Q_{min} when gas is flowing. These are 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 are considered to be likely to be operating at or around Q_{max} when gas is flowing. These are 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 them represents the net over- or under-read in the population.

- A net under-read for any given LDZ results in permanent Unidentified Gas equal to the value of the under-read.
- A net over-read for any given LDZ results in the raw estimate of Unidentified Gas being over-stated, and it is therefore adjusted down by the value of the over-read.

6.7 Detected Theft

Detected theft is a temporary source of UG and it is therefore quantified and subtracted from the total UG based on year of occurrence. Data regarding theft details is provided by Xoserve. These theft volumes are used directly in the calculation and are split into the relevant year of occurrence to ensure the theft subtracted relates to the correct formula year.

The detected theft calculation is carried out in a spreadsheet using a macro to calculate the portion of the formula year that a particular theft was estimated to have occurred as follows:

1) For each theft record and for each formula year:

    a. Calculate the Portion of the formula year that theft occurred. There are four scenarios:

        i. The theft starts and ends within the formula year (the portion of the year is simply the theft end date minus the theft start date and then divided by the number of days in a year)

        ii. The period of theft spans the formula year in question (the portion of the year is set to 1)

        iii. The theft is estimated to start in the formula year in question and end in the following formula year. In this case the difference between the end of the formula year and theft start date is used, divided by the number of days in a year.

        iv. The theft is estimated to end in the formula year in question and had started in a previous formula year. In this case the difference between the start of the formula year and theft end date is used, divided by the number of days in a year.

    b. Calculate the theft rate per year which is the total estimate of detected theft divided by the period of theft in years. This is only used as an interim calculation for working out the theft in each formula year and is not used for general theft rate analyses as some of the periods of theft are small resulting in unrealistic theft rates. For this calculation it doesn't matter as we're only ever apportioning the amount of theft estimated to have been detected.

c. Calculate the amount of theft estimated to have occurred in the year in question by multiplying the portion of the formula year that the theft occurred and the theft rate per year.

2) Aggregate all thefts by formula year – these are then applied as corrections to the final UG calculations as detected theft is temporary.

6.8 Balancing Factor

The Balancing Factor (which is predominantly undetected theft) is split between market sectors using the Throughput Method. This is a very simple method that splits this element of UG in the same proportion as SSP/NDM LSP throughput. The analysis presented in Section 6.1 above shows that under current assumptions, no Balancing Factor gas comes from DM sites. The market sector split is calculated using seasonal normal adjusted consumption values, and the ratio of LSP seasonal normal throughput to the total seasonal normal throughput T^{LSP} is given by

$$T^{LSP} = \frac{Tput_{SN}^{LSP}}{\left(Tput_{SN}^{LSP} + Tput_{SN}^{SSP}\right)}$$

where $Tput_{SN}^{LSP}$ and $Tput_{SN}^{SSP}$ are the total LSP and SSP throughputs calculated over the same four formula years as the total UG, corrected to seasonal normal conditions. These values also include any directly calculated UG associated with the relevant market sector. $Tput_{SN}^{LSP}$ is calculated as follows (and $Tput_{SN}^{SSP}$ is calculated in a similar way):

$$Tput_{SN}^{LSP} = \sum_{LDZ=1}^{13} \sum_{yr=1}^{4} \left(SNCons_{LDZ,yr}^{LSP} + UGPerm_{LDZ,yr}^{LSP}\right)$$

where

$SNCons_{LDZ,yr}^{LSP}$ = Calculated seasonal normal annual consumption for all Larger NDM supply point components

$UGPerm_{LDZ,yr}^{LSP}$ = Total permanent directly calculated component of UG for all Larger NDM supply point components (includes Shipperless sites, Unregistered sites and iGT CSEPs) occurring over the relevant year.

The resulting factor (T^{LSP}) is used when calculating the LSP permanent UG as described in Section 6.9.

6.9 Extrapolation to Forecast Period and Aggregation of Final National UG Figure

For 2015/16 the Unidentified Gas figures are trained on data from formula years 2009-2012, with values for both permanent and temporary UG calculated for each training year. Although the analysis of UG is carried out on an LDZ by LDZ basis, the final UG figures will be based on the combined national total (and split into the LSP and SSP market sectors).

The total UG is calculated for the training period (four historic years) using the Consumption Method described in detail in Section 6.3, and the permanent total for each year is obtained by subtracting

temporary UG from it. For the forecast year, the total permanent UG is obtained by extrapolating permanent UG from each category (both the Balancing Factor and the directly calculated elements) forward to the relevant year and summing the resultant values. There is no requirement for an additional independent estimation of the permanent UG total for the forecast year. The method of extrapolation differs depending on the UG category. This section contains a brief summary of the process for each category to clarify how permanent UG is calculated for the forecast year.

Unregistered and Shipperless

The general principle used in previous years for both Unregistered and Shipperless sites is that an estimate of the UG from them is calculated for the most recent year for which snapshot data is available. An assumption is made that the process is steady and so the annual values thus calculated are used for each of the training years and for the forecast year. This approach is necessary because it is not possible for Xoserve to produce a history of the Unregistered/Shipperless report and hence the actual UG from this source during the training years cannot be calculated. Hence it must be estimated. This principle has had to be amended wherever a UNC modification has affected or will affect the levels of UG for any given category. At the time of writing this is now the case for all Unregistered and Shipperless categories of UG. The effects of each relevant modification are applied as described below:

- **Shipper Activity, Orphaned Sites**

  The calculation method for the 2015/2016 formula year will depend on how Mod 0410A affects these categories, and there is currently too little data available to assess this accurately. Therefore each potential method is described here.

  - Both UG categories will be split into two sections: MPRNs created before 01/09/2013 (pre-Mod 0410A sites) and MPRNs created on or after 01/09/2013 (post-Mod 0410A sites). Each is analysed separately.

  - After September 2014, no new pre-Mod 0410A sites can enter either UG category because this is the last point at which MPRNs created before 01/09/2013 can cross the 12-month threshold and pass into Shipper Activity and Orphaned. Therefore from this point on the pre-Mod 0410A element of both categories will consist of a decaying legacy population, with the September 2014 snapshot used as the start point for the decay curves. Values from these curves will be used to determine the proportion of this UG remaining at each snapshot time in the forecast year 2015/16.

  - If Mod 0410A results in no sites remaining Unregistered for more than 12 months, the post-Mod 0410A element of Shipper Activity and Orphaned will be zero. If, however, post-Mod 0410A Unregistered sites continue to be unresolved after 12 months and hence continue to enter these categories after September 2014, the magnitude of this element must be modelled. This will be done by first calculating the total UG (pre-Mod 0410A plus post-Mod 0410A) for each category and extrapolating this to the forecast period. This will be done using one of three forecast methods, with the choice between them based on observed behaviour during the one-year calculation period:

    - If the magnitude of these UG categories remains constant across the calculation period despite the introduction of Mod 0410A, the current method (assumption of a steady process) will be used to extrapolate to the forecast year.

- If a step change occurs after which the magnitude remains steady at its new level, the average of those snapshots at the new level will be used.
- If Mod 0410A results in a trend across the calculation period, this trend will be used to extrapolate to the forecast year.

A series of post-Mod 0410A snapshots will be analysed in order to identify which scenario is occurring in practice, and based on this the appropriate extrapolation method will be used. Details of the chosen method and the reasons for using it will be supplied with the UG estimates. Once the extrapolation method has been chosen, the post-Mod 0410A UG for the forecast year will be calculated as the difference between the total UG (estimated as described) and the pre-Mod 0410A UG (calculated using the decay method).

- **Unregistered <12 Months**

  Mod 0410A affects this category in a manner similar to how it affects Shipper Activity and Orphaned, except that in this case any effect will begin to influence the level of UG immediately after the effective date of the Mod (01/09/2013). By the time of the forecast year, there will be no pre-Mod 0410A element of this UG category because any remaining pre-Mod 0410A sites will have been Unregistered for more than 12 months and hence have entered Shipper Activity or Orphaned. This leaves post-Mod 0410A as the only remaining element, and depending on the observed behaviour of these sites across a number of training snapshots, any of the following extrapolation options may be appropriate:

  - If the magnitude of this UG category remains consistent across the calculation period despite the introduction of Mod 0410A, the current method (assumption of a steady process) will be used to extrapolate to the forecast year.
  - If a step change occurs after which the magnitude remains steady at its new level, the average of those snapshots at the new level will be used.
  - If Mod 0410A results in a trend across the calculation period, this trend will be used to extrapolate to the forecast year.

  Details of the chosen method and the reasons for using it will be supplied with the UG estimates.

- **Shipperless PTS**

  All sites entering this category after April 2014 (i.e. a year after the introduction of Mod 0424) will contribute temporary UG only. Therefore, permanent UG for the 2015/16 formula year is calculated using only the decay in legacy sites. The May 2014 snapshot acts as the start point for this process, and the decay is modelled from this point on using the techniques described in Section 6.4 above. This decay curve is extrapolated to the 2015/16 formula year to give the permanent UG from this source for the forecast period.

- **Shipperless SSrP**

  Mod 0425 affects this UG category in the same way that Mod 0424 affects Shipperless PTS. In this case, however, the Mod became effective on 01/04/2014 and therefore the final snapshot that can

contain new permanent UG is May 2015. Given that this lies in the future, the contents of this snapshot, including the temporary/permanent split of the gas in it, must be estimated as described in Section 6.4. This acts as the start point for the decay curves that are used to model permanent UG from this point onwards for the 2015/16 formula year.

- **Without a Shipper <12 Months**

  This category consists of two types of site: those that will go on to become Shipperless PTS and those that will become Shipperless SSrP. The permanent element of the Shipperless PTS element will drop to zero for the 2015/16 formula year due to the effects of Mod 0424. For the Shipperless SSrP element, under the terms of Mod 0425 any sites where the install date of the new meter is unknown will still consume permanent UG. This will be estimated for the calculation period and the same estimate used for the forecast period (i.e. an assumption of a steady process).

iGT CSEPs

This category of UG is split into two elements: Unknown Projects and Unregistered sites on known CSEPs. Data for Unknown Projects is supplied in bi-monthly snapshots, which allows a trend to be identified over time for each individual LDZ and market sector. Given that the available snapshots do not cover either the whole training period or the forecast period, the trends are used to extrapolate backwards (to get the iGT CSEPs UG for the years of the training period) and forwards (to get the iGT CSEPs UG for the forecast year).

Data for Unregistered sites on known CSEPs has not been made available on a regular basis to date. Only two instances of this dataset have been provided, dated April 2011 and July 2013. As it is not possible to calculate a reliable trend based on two data points, it is necessary to simply use the dataset that is closest in time for each year of interest. Therefore, in the UG calculations presented in the 2013 AUGS for 2014/15 [29], for the training years the April 2011 figures were used as the best estimate of UG from this source. For the forecast year, the July 2013 figures were used as the best estimate. Updated data has been requested from Xoserve and this will be used in the production of UG estimates for the 2015/16 year. Whilst a reliable trend still cannot be produced from three snapshots, this new dataset will allow 2014 figures to be applied in the forecast year calculations rather than those from 2013, and these will be more accurate due to their closer proximity to the forecast year.

The total iGT CSEPs UG for each year of interest is calculated by summing the two elements described above.

Consumer Metering Errors

This category of UG is typically small. An assumption is made that the process is steady, and therefore single estimates of the figures for each LDZ/market sector combination are applied to each historic year and taken forward to the forecast year.

Detected Theft

Detected theft is temporary in nature and hence is used only in the calculations for the training period. No permanent UG arises from this source and therefore nothing is taken forward to the forecast year.

Balancing Factor

The Balancing Factor is calculated individually for each year of the training period by subtracting all of the directly estimated categories of UG from the total UG derived using the Consumption Method. An assumption is made that the process is steady, and therefore the average Balancing Factor across the years of the training period is a good approximation of the Balancing Factor for the forecast year.

For the 2014 analysis, an additional year of reliable training data is available. The decision has been made to use this year in addition to the previous three years so that the Balancing Factor is now based on an average of four years of historic data. This will give a better estimate of the Balancing Factor, assuming that this is subject to a year on year statistical variability with no trend. The best estimate of the Balancing Factor for the forecast year (2015/16) is therefore calculated as follows:

$$BF_{LDZ} = \frac{1}{4}\sum_{yr=1}^{4}\left(BF_{LDZ,yr}\right)$$

where

$BF_{LDZ,yr}$ = Total Balancing Factor quantity for a given LDZ, year as defined below

$$BF_{LDZ,yr} = Alloc^{SSP}_{LDZ,yr} + Alloc^{LSP}_{LDZ,yr} + LDZcorr_{LDZ,yr} + DMcorr_{LDZ,yr} - Cons^{LSP}_{LDZ,yr} - Cons^{SSP}_{LDZ,yr} - UG^{Temp}_{LDZ,yr} - DCPUG^{SSP}_{LDZ,yr} - DCPUG^{LSP}_{LDZ,yr}$$

where

$Alloc^{SSP}_{LDZ,yr}$ = SSP Allocations for each LDZ for each year used

$Alloc^{SSP}_{LDZ,yr}$ = LSP Allocations for each LDZ for each year used

$LDZcorr_{LDZ,yr}$ = Total LDZ level meter corrections per LDZ per year

$DMcorr_{LDZ,yr}$ = Total DM and Unique site meter corrections per LDZ per year

$Cons^{SSP}_{LDZ,yr}$ = Calculated total SSP consumptions per LDZ per year

$Cons^{LSP}_{LDZ,yr}$ = Calculated total LSP consumptions per LDZ per year

$UG^{Temp}_{LDZ,yr}$ = Total temporary UG by LDZ by year from the direct calculated UG process including total detected theft

$DCPUG^{SSP}_{LDZ,yr}$ = Directly calculated permanent UG, for the SSP sector, for the forecast year by LDZ

$DCPUG^{LSP}_{LDZ,yr}$ = Directly calculated permanent UG, for the LSP sector, for the forecast year by LDZ

Total Permanent Unidentified Gas

The total permanent UG for the LSP sector (FUG_{LSP}) is calculated by adding the forecast of directly calculated permanent UG for the LSP sector to the LSP portion of the Balancing Factor.

$$FUG_{LSP} = \sum_{LDZ=1}^{13}\left(BF^{LSP}_{LDZ} + DCPUG^{LSP}_{LDZ}\right)$$

where

BF_{LDZ}^{LSP} = Balancing Factor for the LSP sector by LDZ

$$BF_{LDZ}^{LSP} = BF_{LDZ} \times T_{LDZ}^{LSP}$$

where

T_{LDZ}^{LSP} = the ratio of LSP seasonal normal throughput to the total seasonal normal throughput as defined in Section 6.7.

Similar calculations are used for the SSP sector. For DM, there is no contribution from the Balancing Factor, and hence the total permanent UG consists of the relevant directly calculated elements only, extrapolated to the forecast year using the methods described above.

7 UNIDENTIFIED GAS ESTIMATES

The AUG table will be provided separately once the methodology has been approved and will reference the approved statement as appropriate. An example (unpopulated) AUG table is shown below. When completed, this table will show the quantities of UG associated with each SPC, split by source. For the avoidance of doubt, the "Larger DM SPCs" category includes all DMs i.e. DMM, DMV and DME.

Table 5: Example AUG Table

Unidentified Gas source	**Aggregate Quantity of Unidentified Gas**	**Unidentified Gas Quantity**		
		Larger DM SPCs	**Larger NDM SPCs**	**Smaller SPCs**
iGT CSEPs				
Shipperless/Unregistered				
- Shipper Activity				
- Orphaned				
- Unregistered <12 Months				
- Shipperless PTS				
- Shipperless SSrP				
- Shipperless <12 Months				
Meter Errors				
Total Directly Measured				
Balancing Factor (Theft + Other)				
Total				

The AUGE will also provide, for information, a separate AUG table for each LDZ and an estimate of the SAP price for 2015/16 to allow estimation of the overall cost of UG in the coming gas year. In practice the SAP price actually used will be the daily average SAP price over the reconciliation billing period in question and the shipper's relevant aggregate AQ share. This is described in the TPD [6] section E 10.5.

This section of the TPD also requires the AUGE to supply UG information in a slightly different format. This is given in Appendix D and will be provided to ensure the AUGE complies with UNC.

8 CONSULTATION QUESTIONS AND ANSWERS

This section captures a history of the questions raised by industry bodies during the consultation periods and the AUGE's responses. These relate to all drafts of the 2011 AUGS for 2012/13, the 2012 AUGS for 2013/14 and the 2013 AUGS for 2014/15. 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 documents:

- "AUGS Query Responses 30_09_2011" [8]
- "AUGS Draft2 Query Responses 14_11_2011" [9]
- "AUGS Query Responses 19_03_2012" [11]
- "AUGE Responses to 1st Draft 2012 AUGS" [12]
- "AUGE Responses to Interim Report Consultation" [13]
- "AUGE Responses to 2nd Draft AUGS Consultation 12032013" [19]
- "AUGE Responses to 1st Draft AUGS Consultation 25th June 2013" [25]
- "Response to British Gas Query 13th November 2013" [30]
- "ICoSS Query Response 13th November 2013" [31]
- "British Gas Further Queries Response 11th December 2013" [32]
- "British Gas Consultation Response to the 2014 Allocation of Unidentified Gas Statement for 2015_16" [36]

Note that all responses contained in these documents relate to the UG 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 UG 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 6: Responses to the First Draft of the 2011 AUGS

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

Table 7: Responses to the Second Draft of the 2011 AUGS

Organisation Name	Date of Communication
Npower	31/10/2011
ICoSS	31/10/2011
Total Gas and Power	31/10/2011
ScottishPower	31/10/2011
British Gas	31/10/2011

Table 8: Responses to the Final Draft of the 2011 AUGS

Organisation Name	Date of Communication
British Gas	20/02/2012
Inexus	08/03/2012
Shell Gas Direct	08/03/2012

Table 9: Responses to the First Draft of the 2012 AUGS

Organisation Name	Date of Communication
Energy UK	15/06/2012
ScottishPower	15/06/2012
ICoSS	29/06/2012

Table 10: Responses to the September 2012 Interim Report

Organisation Name	Date of Communication
Energy UK	28/09/2012
Gazprom	28/09/2012
Corona Energy	28/09/2012
Npower	28/09/2012
Total Gas and Power	28/09/2012

Table 11: Responses to the Second Draft of the 2012 AUGS

Organisation Name	Date of Communication
ICoSS	01/03/2013
DONG Energy	01/03/2013
Energy UK	01/03/2013
RWEnpower	01/03/2013
ScottishPower	01/03/2013
SSE Energy Supply	01/03/2013
British Gas	01/03/2013

Table 12: Responses to the First Draft of the 2013 AUGS

Organisation Name	Date of Communication
ICoSS	12/06/2013
DONG Energy	12/06/2013
RWEnpower	12/06/2013
Scottishpower	12/06/2013
British Gas	12/06/2013

Table 13: Responses to the Second Draft of the 2013 AUGS

Organisation Name	Date of Communication
RWEnpower	05/08/2013

Table 14: Responses to the Final Draft of the 2013 AUGS

Organisation Name	Date of Communication
ICoSS	27/09/2013
British Gas	13/11/2013
British Gas	19/11/2013

Table 15: Responses to the First Draft of the 2014 AUGS

Organisation Name	Date of Communication
British Gas	11/06/2014

9 CONTACT DETAILS

Questions can be raised with the AUGE at AUGE.software@dnvgl.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 0194 Framework for correct apportionment of NDM error

[3] Mod 0194a Framework for correct apportionment of LSP unidentified gas

[4] Mod 0228/0228A Correct apportionment of NDM Error – Energy

[5] Mod 0229 Mechanism for Correct Apportionment of Unidentified Gas implemented in UNC Section E 10 v3.54 26th April 2011

[6] Uniform Network Code - Transportation Principal Document

[7] Mod 0398: Limitation on Retrospective Invoicing and Invoice Correction Version 6.0, 28 August 2012

[8] AUGS Draft 1 Query Responses, September 2011

[9] AUGS Draft 2 Query Responses, November 2011

[10] AUGS Final (Version 4), December 2011

[11] 2011 AUGS for 2012/13 Query Responses 19_03_2012, March 2012

[12] AUGE Responses to 1st Draft 2012 AUGS for 2013_14 Consultation, July 2012

[13] AUGE Responses to Interim Report Consultation 17102012, October 2012

[14] Modification 0429 Version 4.0, 27 January 2013

[15] Final Modification Report 0424 Version 4.0, 20 December 2012

[16] Draft Modification Report 0425 Version 1.0, 21 March 2013

[17] AUGS Query Responses 30_09_2011, September 2011

[18] 2012 AUGS for 2013/14 Final Version, December 2012

[19] AUGE Responses to 2nd Draft AUGS Consultation 12032013, March 2013

[20] Modification 0410A Version 7.0, 12 November 2012

[21] Mod 0398 OFGEM decision letter 1 March 2013

[22] Mod 0282 Introduction of a process to manage Vacant sites 2010/11

[23] Estimation of CSEP Leakage, Roy Malin, National Grid Distribution, 22nd February 2013

[24] SPAA Schedule 33 "Theft of Gas Code of Practice" from version 9.4 of SPAA ,1st April 2013

[25] AUGE Responses to 1st Draft 2013 AUGS Consultation, 25th June 2013

[26] Xoserve Customer Discovery Day – Reconciliation presentation, 22nd November 2012

[27] Tackling Gas Theft: Final Impact Assessment, OFGEM, 26th March 2012

[28] Direction under paragraph 8 of condition 12A of the Standard Conditions of the Gas Supply Licence to introduce the Theft Risk Assessment Service, OFGEM, 7th January 2013

[29] 2013 AUGS for 2014/15 Version 3 (final), 26th September 2013

[30] Response to British Gas Query, 13th November 2013

[31] ICoSS Query Response 13th November 2013

[32] British Gas Further Queries Response 11th December 2013

[33] Gas Governance Website, www.gasgovernance.co.uk

[34] Final Modification Report 0392 Version 2.0, 15 December 2011

[35] Presentation from Scottish Power, UNC Mod 0392 and IGT040, 17 August 2011

[36] British Gas Consultation Response to the 2014 Allocation of Unidentified Gas Statement for 2015_16

[37] AUGE Response to British Gas Consultation Response, 27 June 2014

GLOSSARY

AGI	Above Ground Installation
ALP	Annual Load Profile (deeming algorithm parameter)
AQ	Annual Quantity. An estimate of annual consumption under seasonal normal conditions
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.
Consumption Method	Unidentified Gas methodology using meter reads and metered volumes
CSEP	Connected System Exit Point
CV	Calorific Value
CWAALP	Cumulative Weather Adjusted Annual Load Profile
CWV	Composite Weather Variable
DAF	Daily Adjustment Factor (deeming algorithm parameter)
DM	Daily Metered
DME	Daily Metered Elective. A site below the DM mandatory threshold of 58,600,000 kWh which the shipper has elected to be DM. The meter read equipment is provided by the shipper.
DMM	Daily Metered Mandatory. A site with an AQ above the DM mandatory threshold of 58,600,000 kWh.
DMV	Daily Metered Voluntary. A site below the DM mandatory threshold of 58,600,000 kWh which is voluntarily DM. The meter read equipment is provided by the transporter.
ECV	Emergency Control Valve
EUC	End User Category
EWCF	Estimated Weather Correction Factor (deeming algorithm output - alternative to WCF based on CWV rather than demand)
Found Meter	A meter being supplied by a Shipper but for which Xoserve have no record
GSR	Gas Safety Regulations
IGT	Independent Gas Transporter

Isolated Meter	A meter that has been disabled (through capping or clamping) and hence is no longer capable of flowing gas, and this information has been conveyed to Xoserve and recorded on their system.
LDZ	Local Distribution Zone
LSP	Larger Supply Point
MAM	Meter Asset Manager
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
ODR	OFGEM Data Request
OUG	Own Use Gas
PSND	Pseudo Seasonal Normal Demand, calculated using AQ values rather than being based on historic metered demands
PTS	Passed To Shipper
RbD	Reconciliation by Difference
RbD-based Method	The methodology developed and approved in 2011 AUGS for 2012/13
RPD Meter	Rotary Positive Displacement meter
SAP	System Average Price
SF	Scaling Factor (deeming algorithm output)
SNCWV	Seasonal Normal Composite Weather Variable
SND	Seasonal Normal Demand
SPC	Supply Point Component
SSP	Smaller Supply Point
SSrP	Shipper Specific rePort
TPD	Transportation Principal Document (of UNC)
UIP	Utility Infrastructure Provider
UNC	Uniform Network Code
UG	Unidentified Gas
WAALP	Weather Adjusted Annual Load Profile
WCF	Weather Correction Factor (deeming algorithm output)
WSENS	Weather Sensitivity (deeming algorithm parameter used in EWCF definition, reflecting the sensitivity of an EUC to difference in CWV from seasonal normal)

APPENDIX A RAW DATA DESCRIPTION

This appendix describes the raw data provided by Xoserve for the consumption method.

ALLOCATIONS

This data contains all allocations including CSEPs from 01/04/2008 onwards.

Name	Description
GAS_DAY	Date - Gas day for which allocation applies
LDZ	Char[2] - LDZ identifier e.g. EA
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
ALLOCATED_ENERGY	Number - Final allocated energy value (kWh). Includes CSEPs

ANNUAL_QUANTITY

This data includes all meter points active at any point from 01/04/2008 onwards, not just those currently live. It includes all within gas year updates, appeals etc.

Name	Description
MPR_ID	Number – Unique dummy ID for meter point which is used consistently throughout the data
AQ_EFFECTIVE_DATE	Date - Date on which AQ becomes effective
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
AQ	Number - Annual Quantity to apply from effective date (kWh)
SITE_TYPE_FLAG	Char[1] - Indicator ="N" for NDM meter point, "D" for DM meter point or "U" for Unique site

CSEPS

This data contains information for formula year 2008 onwards.

Name	Description
FORMULA_YEAR	Date - Formula year for which CSEP AQ/Numbers apply
EUC*	Char[11] - Full EUC Code e.g. WM:E0708W02
TOTAL_AQ	Number - Aggregate CSEP AQ at start of formula year
COUNT_OF_SUPPLY_POINTS	Number - Count of supply points at start of formula year

* Note that the EUC classification for CSEPs is based on a nominal maximum AQ

FACTORS

This data is provided from 1st April 2008

Name	Description
LDZ	Char[2] - LDZ identifier e.g. EA
EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
GAS_DAY	Date - Gas day for which factors applies
ALP	Number - Annual Load Profile (6 d.p.)
DAF	Number - Daily Adjustment Factor (6 d.p.)
EWCF	Number - Estimated Weather Correction Factor (8 d.p.)
CV	Number - Calorific Value (1 d.p.)

METER_READS

This data includes all meter reads from 01/04/2008 onwards. Multiple records for a meter point with the same date are filtered by Xoserve using the following methodology.

Where there is an A (Actual) Read Type and an E (Estimate) Read Type Xoserve remove the E and retain the A Read. Where there are Read Types of R (Replacement) Xoserve retain this read and remove the original read type that it replaced. Where there are multiple R Reads they are ranked by number e.g. R01 and R02 and the highest number is the latest replacement read that is retained.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
START_READ_DATE	Date – Start date of metered period
METER_READ_DATE	Date - Date of meter read
IMP_IND	Char[1] - Indicator ="Y" for imperial meter read, else "N"
METER_READ_VAL	Number - Value of meter read
METERED_VOL	Number - volume of gas since previous meter read in units appropriate for meter (imperial or metric)
ROUND_THE_CLOCK_IND	Number – Number of times the meter index has passed zero since the last read.
AQ	Number – Prevailing Annual Quantity at time of meter read (kWh)
METER_READ_FREQ	Char[1] - Indicator for frequency of meter reads (A-Annual, 6-6 monthly, M-monthly)
SSP_LSP	Char[3] - "SSP" or "LSP"

EUC	Char[11] - Full EUC Code e.g. WM:E0708W02
READ_TYPE_CODE	Char[4] - Code for type of meter read

The read type codes are as follows:

Code	**Description**
A	Agreed between Shippers
AR01	Actual Read (Replacement)
B	Xoserve estimated unbundled or opening read
C	End user read (bundled)
D	Xoserve estimated unbundled final read
E	Estimated / Automatic
F	Final read for metering transaction
G	Gas card Read (Opening)
I	Information read
J	Further read agreed between Shippers, used for final unbundled meter reads
K	End user read provided by the Shipper
L	Further read not agreed between Shippers, used for final unbundled read
M	Estimated (manual)
N	A Normal / Firm read
O	Opening read for metering transaction
P	Opening read for corrector transaction
Q	Shipper Provided Estimated Read
R	Replacement read
S	Shipper provided read
T	Transfer of ownership
U	Meter reading organisation read, provided by the Shipper
V	Cyclic read from MRA and is used for Shipper transfer
W	Cyclic read from Shipper used for transfer

Code	Description
X	Remote Reading Equipment Read (Normal)
XROx	Remote Reading Equipment Read (Replacement)
Y	Remote reading Equipment Read (Opening)

METER_INFO

This data includes all available meter asset data.

Name	Description
MPR_ID	Number - Unique ID for meter used across ALL data
LDZ	Char[2] - LDZ identifier e.g. EA
NUM_DIALS	Number - Number of meter dials
IMP_IND	Char[1] - Indicator ="Y" for imperial meter read, else "N"
METER_FITTED_DATE	Date - Date meter was fitted
UNITS	Number - Multiplier for meter read units (1, 10, 100 etc)
CORRECTION_FACTOR	Number – Volume correction factor
STATUS_UPDATE_DATE	Date – Date of record
METER_STATUS	Char[27] – e.g. Live, Removed

MMSPS

This data includes details of all MMSPs active at any time since 01/04/2008.

Name	Description
MPR_ID	Number - Unique ID for meter used across ALL data
SUPPLY_POINT_ID	Number - Unique dummy ID for supply point
LDZ	Char[2] - LDZ identifier e.g. EA
CONF_EFFECTIVE_DATE	Date
CONF_END_DATE	Date

NEW_LOST_SITES

This data contains all meter points with a first confirmation date or an end date from 01/04/2008 onwards.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
START_DATE	Date - First confirmation date for meter point
END_DATE	Date - Date meter point was excluded from allocations process

PRIMES

This data includes details of all prime meter points active at any time since 01/04/2008.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
LDZ	Char[2] - LDZ identifier e.g. EA

SUBS

This data includes details of all sub-prime meter points active at any time since 01/04/2008.

Name	Description
MPR_ID	Number - Unique dummy ID for meter point which is used consistently throughout the data
PRIME_MPR_ID	Number – Dummy ID for the prime meter

APPENDIX B CONSUMPTION ALGORITHM DATABASE DESCRIPTION

This appendix describes the data structure used by the AUGE to store the data required for the consumption analysis.

The majority of data is stored in separate tables for each LDZ. The two letter abbreviation for each LDZ is appended to the name of the relevant tables. This is denoted below by _XX. Where a database field is described as raw data it contains unprocessed data from Xoserve. All other fields are derived from this information.

There is a database package which encodes the consumption algorithm. It is run by calling Consumption.CalculateFullRun;

ANNUAL_QUANTITY_XX

Name	Description
MPR_ID	Raw data
AQ_EFFECTIVE_DATE	Raw data
EUC	Char[5] – Strip LDZ and year from full EUC Code to give e.g. 08W02
AQ	Raw data
SITE_TYPE_FLAG	Raw data
LDZ	Char[2] - taken from first 2 digits of EUC
EUC_CALC	Char[3] - EUC consumption band calculated from AQ e.g. 01B – Needed to handle supply points containing multiple meter points.

EUC_CALC

This field is calculated using a function defined in the database called Calc_EUC_Band which returns an EUC band given an AQ using the following logic:

if AQ ≤ 73,200 then '01B'

else if AQ ≤ 293,000 then '02B'

else if AQ ≤ 732,000 then '03B'

else if AQ ≤ 2,196,000 then '04B'

else if AQ ≤ 5,860,000 then '05B'

else if AQ ≤ 14,650,000 then '06B'

else if AQ ≤ 29,300,000 then '07B'

else if AQ ≤ 58,600,000 then '08B'

else '09B'

FACTORS

There is a daily version containing the following information for 01-Apr-2008 onwards

Name	Description
LDZ	Char[2] - LDZ identifier e.g. EA
EUC_BAND	Char[5] – EUC band e.g. 08W02
GAS_DAY	Raw data
ALP	Raw data
DAF	Raw data
EWCF	Raw data
WC	Number - Max(0.01, 1 + DAF * EWCF)
CV	Raw data
WAALP	Number - ALP * WC
VOL_WAALP	Number - WAALP / CV

Then to help speed up the consumption algorithm there is a yearly version which aggregates the WAALP and VOL_WAALP by formula year.

Name	Description
LDZ	Char[2] - LDZ identifier e.g. EA
EUC_BAND	Char[5] – EUC band e.g. 08W02
F_YEAR	Number - Formula year
CWAALP	Number - Sum WAALP
VOL_CWAALP	Number - Sum VOL_WAALP

LDZ_MOVERS

Name	Description
MPR_ID	Raw data
OLD_LDZ	Char[2]
NEW_LDZ	Char[2]

Some meters have records associated with more than one LDZ. These meters are identified and their MPR_ID is recorded in a separate table which also includes the latest LDZ they are recorded against and any previous LDZs. Any data associated with a meter which is not for the latest LDZ is then copied to the appropriate LDZ. This is required as processing is done on an LDZ by LDZ basis with data held in separate LDZ specific tables. This copying of data ensures that when the meter consumption is calculated in the latest LDZ, all of the relevant data is present. To ensure no double counting occurs, the SITE_LIST tables are populated to ensure that each meter is only present in one LDZ (its latest LDZ).

METER_INFO_XX

Name	Description
MPR_ID	Raw data
LDZ	Raw data
NUM_DIALS	Raw data
IMP_IND	Raw data
METER_FITTED_DATE	Raw data
UNITS	Raw data
CORRECTION_FACTOR	Raw data
UNITS_CALC	Number - Units estimated from meter reads
IMP_IND_CALC	Char[1] – Indicator flag taken from meter read records.
STATUS_UPDATE_DATE	Raw data
METER_STATUS	Raw data

UNITS_CALC

This field is derived using the following method:

For each MPR, for each pair of meter reads (mr_1, mr_2) check

- The meter was not replaced in between
- $mr_2 - mr_1 > 0$
- metered volume (mv_2) associated with $mr_2 > 0$
- round the clock indicator associated with $mr_2 = 0$
- gap/overlap indicator associated with $mr_2 = 0$

If yes to all, calculate

$$Ratio = mv_2 / ((mr_2 - mr_1) * CF)$$

$$A = log_{10}(Ratio)$$

$$B = abs([A] - A)$$

where *CF* is the T&P correction factor (taken from the meter asset data) and *[A]* denotes the integer part of *A*.

If

- $0 \leq [A] \leq 4$
- $B < 0.002$

Then set $units\_calc = 10^{[A]}$. We then look up the latest meter_info entry prior to the meter reads and update the units_calc field. If no such entry exists a new dummy record is inserted with an installation date = mr_1_date -1 and default values for the other fields.

IMP_IND_CALC

This field is the IMP_IND flag taken from the meter read records for the meter. It is stored here for comparison with the value from the meter asset data.

METER_READS_XX

Name	Description
MPR_ID	Raw data
START_READ_DATE	Raw data
METER_READ_DATE	Raw data
IMP_IND	Raw data
METER_READ_VAL	Raw data
METERED_VOL	Raw data

Name	Description
ROUND_THE_CLOCK_IND	Raw data
AQ	Raw data
METER_READ_FREQ	Raw data
SSP_LSP	Raw data
EUC	Char[5] – Strip LDZ and year from full EUC Code e.g. 08W02
READ_TYPE_CODE	Raw data
LDZ	Char[2] - taken from first 2 digits of EUC
BAD_READ	Char[1] - Indicator ="Y" don't use meter read
GAP_OVERLAP	Number – Positive indicates a gap, negative indicates an overlap
VOLUME_CORRECTION	Number- Difference between metered volume and calculated volume since the last read

BAD_READ

The algorithm for flagging bad reads is as follows:

Given sequential meter reads mr_1, mr_2, mr_3 and mr_4 calculate:

$$con_1 = mr_2 - mr_1$$

$$con_2 = mr_3 - mr_2$$

$$con_3 = mr_4 - mr_3$$

If any of these are negative we check for meter index rollover

If the meter was replaced we leave the consumption null

Then if the meter was not replaced during the period we check

- If ($con_3 > 0$) and ($con_2 < 0$) and ($con_1 > 0$) then we have a bad reading
- If $con_1 >$ abs(con_2) then mr_2 is bad
- Else if $con_3 >$ abs(con_2) then mr_3 is bad

GAP_OVERLAP

This field is the number of days between the start read date for a records and meter read date from previous record.

- A positive value indicates a gap
- A negative value indicates an overlap

Note, start read dates are only available for the records provided from 2013 onwards.

VOLUME_CORRECTION

For the records with a gap/overlap this field is the difference between the volume consumed between that record and the previous read (calculated using the meter read values and relevant asset data) and the recorded metered volume.

NDM_DM_CHANGE

This table is pre-calculated from the AQ records

Name	Description
MPR_ID	Number - Unique ID for meter point used across ALL data
NDM_START_DATE	Date – date when site becomes NDM
NDM_END_DATE	Date – date when site becomes DM
LDZ	Char[2] - LDZ identifier e.g. EA

The entries in this table are calculated manually. The first step is to list the MPRs from the AQ records which are recorded as both DM and NDM. Then by inspecting the AQ records for each MPR determine the start and end date of its NDM status.

RESULTS_XX

Name	Description
MPR_ID	Number
LDZ	Char[2]
EUC	Char[5] – taken from AQ record
F_YEAR	Number – Formula year
CONSUMPTION	Number – Consumption (in kWh) for formula year calculated using meter reads / metered volumes
OLD_AQ	Number - AQ (in kWh) chosen during consumption algorithm.
NEW_AQ	Number – Updated AQ estimate (in kWh) based on consumption value.
METER_READS	Char[1] - Indicator ="Y" found two meter reads which satisfy the criteria listed in the algorithm

Name	Description
POSITIVE_VOLUME	Char[1] - Indicator ="Y" positive volume calculated after possibly correcting for meter index rollover
AQ_CHECK	Char[1] - Indicator ="N" if FY_MR_CON puts the site into the LSP market and is >5 times the consumption calculated using the AQ
YEAR_FRACTION	Number – (0<= <=1) fraction of the year for which the site was active (calculated using the ALPs)
EUC_CALC	Char[3] – Consumption band calculated based on consumption from meter read data if calculated successful, else on the AQ
OLD_AQ_DATE	Date – Effective date for the old AQ
METER_ASSET_DATE	Date – Installation date for the meter in place during the metered period
START_READ_DATE	Date – Date of the start meter read used in the calculation
END_READ_DATE	Date – Date of the end meter read used in the calculation
CALC_TIMESTAMP	Date – Date and time calculation was carried out

SITE_LIST_XX

This table is populated with a unique list of MPR ids from the AQ table. Start and end dates taken from NEW_LOST_SITES and NDM_DM_CHANGE tables.

Name	Description
MPR_ID	Number
START_DATE	Date – Date from which the site is active and NDM
END_DATE	Date – Date from which the site ceases to be active or NDM

MPR_ID

These are taken from the AQ records for each LDZ. We then identify meter points which "move LDZ" and remove their ID from the site_list for the incorrect LDZ.

START_DATE, END_DATE

These are generated based on the NEW_LOST_SITE table and the NDM_DM_CHANGE table. Special care needs to be taken off "lost" sites which then become active again at a later date.

APPENDIX C WORKED EXAMPLE OF CONSUMPTION ALGORITHM

This appendix shows the consumption algorithm, described in Section 6.3.2, applied to example data.

Full Example

To calculate the consumption for MPR_ID 913600 (which is in EA LDZ) for formula year 2009 the following steps are taken:

1. Check the site is active and NDM in 2009: Yes
2. Select a representative AQ. In this case the AQ from 1/10/2010 is used as the meter reads it is based on are most representative of the demand for 2009/10.

MPR_ID	AQ EFFECTIVE DATE	EUC	AQ	SITE TYPE FLAG	LDZ	EUC_CALC
913600	01/10/2007	01B	7544	N	EA	01B
913600	01/10/2008	01B	5523	N	EA	01B
913600	01/10/2009	01B	9457	N	EA	01B
913600	**01/10/2010**	**01B**	**10477**	**N**	**EA**	**01B**
913600	01/10/2011	01B	11505	N	EA	01B

3. Find candidate meter read dates (see meter read table overleaf)

LB1	LB2	UB1	UB2
19/03/2009	28/04/2009	18/01/2010	12/04/2010

4. Choose the best two

   LB1-'01-apr-2009' < 540 and no meter replacement since 20/11/2008 so use LB1

   UB2-'31-mar-2010'< 540 and no meter replacement since 20/11/2008 so use UB2

5. Validate the choice of meter reads

   UB2 – LB1 > 120

   (LB1, UB2) intersection (’01-apr-2009’, ’31-mar-2010’) > 60

   So we have found two valid reads

MPR ID	METER READ DATE	IMP IND	METER READ VAL	METERED VOL	ROUND THE CLOCK IND	AQ	EUC	LDZ	BAD READ	
913600	20/11/2008	N	5707	211	0	5523	01B	EA	N	
913600	02/03/2009	N	6229	534	0	5523	01B	EA	N	
913600	**19/03/2009**	**N**	**6275**	**47**	**0**	**5523**	**01B**	**EA**	**N**	**LB1**
913600	28/04/2009	N	6400	128	0	5523	01B	EA	N	LB2
913600	28/08/2009	N	6455	56	0	5523	01B	EA	N	
913600	18/01/2010	N	6964	521	0	9457	01B	EA	N	UB1
913600	**12/04/2010**	**N**	**7438**	**485**	**0**	**9457**	**01B**	**EA**	**N**	**UB2**
913600	01/06/2010	N	7518	82	0	9457	01B	EA	N	
913600	14/12/2010	N	7928	419	0	10477	01B	EA	N	
913600	22/08/2011	N	8665	58	0	10477	01B	EA	N	
913600	15/11/2011	N	8844	183	0	11505	01B	EA	N	
913600	04/02/2012	N	9340	507	0	11505	01B	EA	N	
913600	27/07/2012	N	9968	642	0	11505	01B	EA	N	

6. Calculate the volume consumed between the two meter reads:

   Site is an 01B so calculate volume as difference of meter reads

   Difference = 7,438 – 6,275 = 1,163

   This is positive. The meter is metric and has been predetermined to have read units=1

   Therefore the final volume is 1,163 * 1.022640 = 1,189.33 m^3 (Compared to 1,190 m^3 if we had used the metered volumes in this case)

7. Calculate consumption for formula year 2009 based on meter reads

   The meter was active for the whole year, so

   Volume taken over the year is = 1,189.33 * sum volume profile over 2009 / sum volume profile over metered period

   =1,189.33 * 9.40 / 10.19

   =1,097.12 m^3

   Weighted average CV for 2009 is = 370.46 / 9.40 = 39.40

   Therefore consumption = 1097.12 * 39.40 / 3.6 = 12,007.51 kWh

8. Calculate a new AQ based on this consumption and compare it to the AQ chosen earlier

   New AQ = consumption * 365 / CWAALP = 12,007.51 * 365 / 370.46 = 11,830 kWh

   This makes the site still 01B and is consistent with the old AQ estimate

Example of Meter Index Roll Over Detection Algorithm

Given the following meter reads:

MPR ID	METER READ DATE	IMP IND	METER READ VAL	METERED VOL	ROUND THE CLOCK IND	AQ	EUC	LDZ	READ TYPE CODE	BAD READ
16608022	17/11/2008	Y	8601	21782	0	22310	01B	WN	U	N
16608022	28/05/2009	Y	9086	49598	0	22310	01B	WN	U	N
16608022	**19/11/2009**	**Y**	**9257**	**17487**	**0**	**22826**	**01B**	**WN**	**U**	**N**
16608022	**15/02/2011**	**Y**	**299**	**-916081**	**0**	**19974**	**01B**	**WN**	**U**	**N**
16608022	16/08/2011	Y	572	1050558	1	19974	01B	WN	K	N
16608022	29/02/2012	Y	967	1063034	1	19974	01B	WN	U	N

We initially calculate the difference between the reads to be = 299 – 9,257 = -8,958

As this is negative we test for meter index roll-over

num_dials = round_up(log(10, start_mr)) = round_up(log(10, 9,257)) = round_up(3.97) = 4

max_read = 10^{num_dials} = 10^4 = 10,000

num_years = (15/02/2011 – 19/11/2009) / 365 =1.24

new_diff = (max_read - start_mr + end_mr) = 10,000 – 9,257 + 299 = 1,042

The check is: new_diff / max_read / num_years < 0.25

We have 1,042 / 10,000 / 1.24 = 0.08 > 0.25 so we set the difference to be 1,042 and continue.

APPENDIX D AUG TABLE (UNC FORMAT)

The AUG table in the format specified in the Uniform Network Code [6], Section E10 is as follows. This will be populated along with the table in the format given in Section 7 above when the AUG figures are calculated and released.

Unidentified Gas source	**Aggregate Quantity of Unidentified Gas**	**Unidentified Gas Quantity**		
		Larger DM SPCs (A)	**Larger NDM SPCs (B)**	**Smaller SPCs (C)**
iGT CSEPs				
Shipperless/Unregistered				
- Shipper Activity				
- Orphaned				
- Unregistered <12 Months				
- Shipperless PTS				
- Shipperless SSrP				
- Shipperless <12 Months				
Meter Errors				
Total Directly Measured				
Balancing Factor (Theft + Other)				
Total				

This table contains UG *adjustments* to the post-RbD market sector totals rather than the value of UG assigned to each market sector. Therefore C=-(A+B).

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