Unaccounted for Gas (UAG) Report

National Grid
Gas Transmission

April 2014

Target audience

Ofgem and other interested industry parties

About this document

This document sets out the work undertaken by National Grid Gas in its role as System Operator, to investigate potential causes of Unaccounted for Gas (UAG).

It is published to meet Special Condition 8E: Requirement to undertake UAG Projects to investigate the causes of UAG.

If you have any feedback or questions on this document please get in contact with us at:

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Background

This report provides a review of National Grid's Unaccounted for Gas (UAG) management covering the period up to and including the 31st March 2014.

A range of UAG related data including:

- All the previous UAG reports
- Daily UAG data

can be found at:

http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/balancing/unaccounted-for-gas

This report discharges National Grid Gas's (NGG's) responsibilities under Special Condition 8E "Requirement to undertake UAG Projects to investigate the causes of Unaccounted for Gas (UAG)", available via the following link:

https://epr.ofgem.gov.uk

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Executive Summary

The underlying levels of NTS Unaccounted for Gas (UAG) have been reducing since 2012. National Grid's concerted UAG programmes of witnessing and data analysis in conjunction with the proactive approach of all asset owners to meter husbandry have been significant contributing factors to this reduction. To maintain the focus of these activities, National Grid conducts all UAG and Shrinkage related activities within a dedicated Operational Compliance team.

While this current downward trend is welcome, it is recognised that to continue to effectively manage UAG, the meter error detection capability of National Grid's data analysis techniques needs further review. Subsequently, a set of initiatives to develop innovative techniques that will complement the existing analytical methods has been proposed.

National Grid also intends to increase its engagement with all asset owners by providing more opportunities to enhance these relationships with the aim of ensuring best practice across the full range of NTS meter management.

National Transmission Unaccounted for Gas Trends

1.1. Annual NTS Shrinkage

The annual NTS shrinkage trend since 2007 is presented in Figure 1.

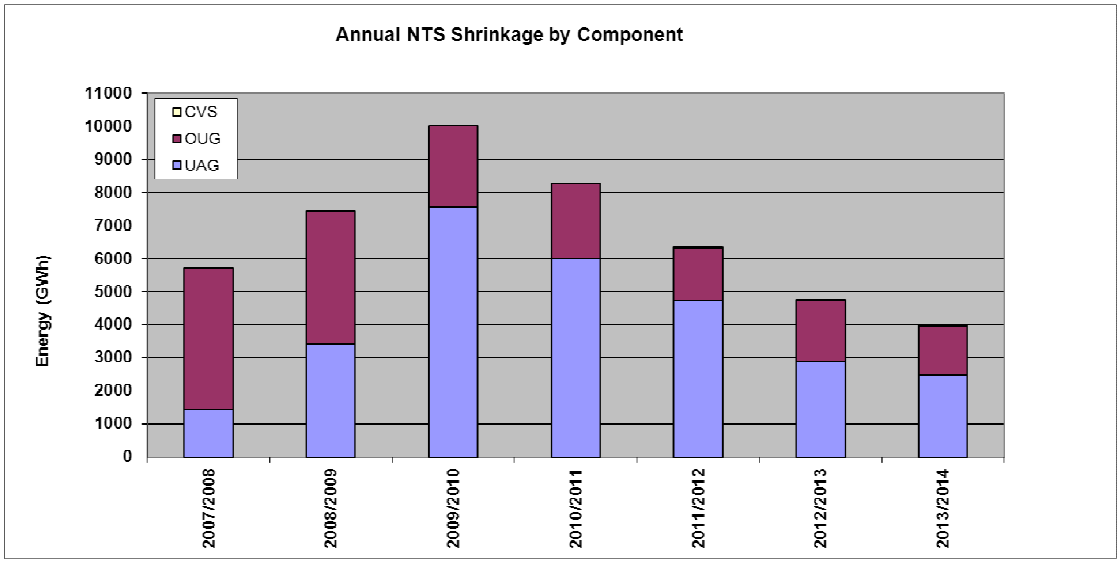

Figure 1: Annual NTS Shrinkage by component since 2007.

The annual shrinkage trend presented in Figure 1 is summarised as:

- The reduction in Own Use Gas (OUG) due to a combination of changes to underlying supply patterns and increased efficiency in compressor operation.
- Low levels of CV Shrinkage (<50 GWh) have been a feature of NTS Shrinkage throughout this period.
- UAG levels continue to show year on year reductions, however this trend has been notably impacted by significant meter errors within the period.

1.2. Unaccounted for Gas

The Unaccounted for Gas (UAG) totals in Figure 1 are presented inclusive of meter error (i.e. assessed) and since 2009 it is the major NTS shrinkage component.

While subsequent meter reconciliations reduced the net UAG positions for the 2009/2012 period (see Section 1.6), it is the post 2012 behaviour that is considered the most indicative of the fundamental trend at the current time as it is free of detected meter error. This view is further supported by the fact that all asset owners will have completed a minimum of two meter validations in this period.

A general set of UAG statistics since 2011 is presented in Table 1. Over this period the observed UAG behaviour has been characterised by reductions in the year on year daily average levels. However, two further indicators suggest that these observed reductions are genuine rather than any dominating systematic bias. These are:

- The standard deviation of the annual values are similar at ~ +/- 21GWh which is indicative of a consistent volatility around the mean values.
- The similarity of the 'Percentage of NTS Throughput' metric since 2012 suggests that the current assessed UAG levels can be considered baseline values. If this wasn't the case the linkage between daily mean values and standard deviations would be more distorted.

	2011/2012	2012/2013	2013/2014
Assessed Annual Level (GWh)	4737	2894	2472
Daily Average (GWh)	12.941	7.929	7.084
2σ (Std. Deviation) (GWh)	22.116	19.308	21.516
Percentage of NTS Throughput	0.45	0.290	0.286

Table 1: Assessed UAG statistical performance since 2011.

The monthly UAG totals since 2012 are presented in Figure 2, indicating that the UAG reductions have been largely consistent across this period. In 2012/13, eleven (11) months had monthly totals in excess of 200 GWh whereas only seven (7) months exceeded this level in 2013/14.

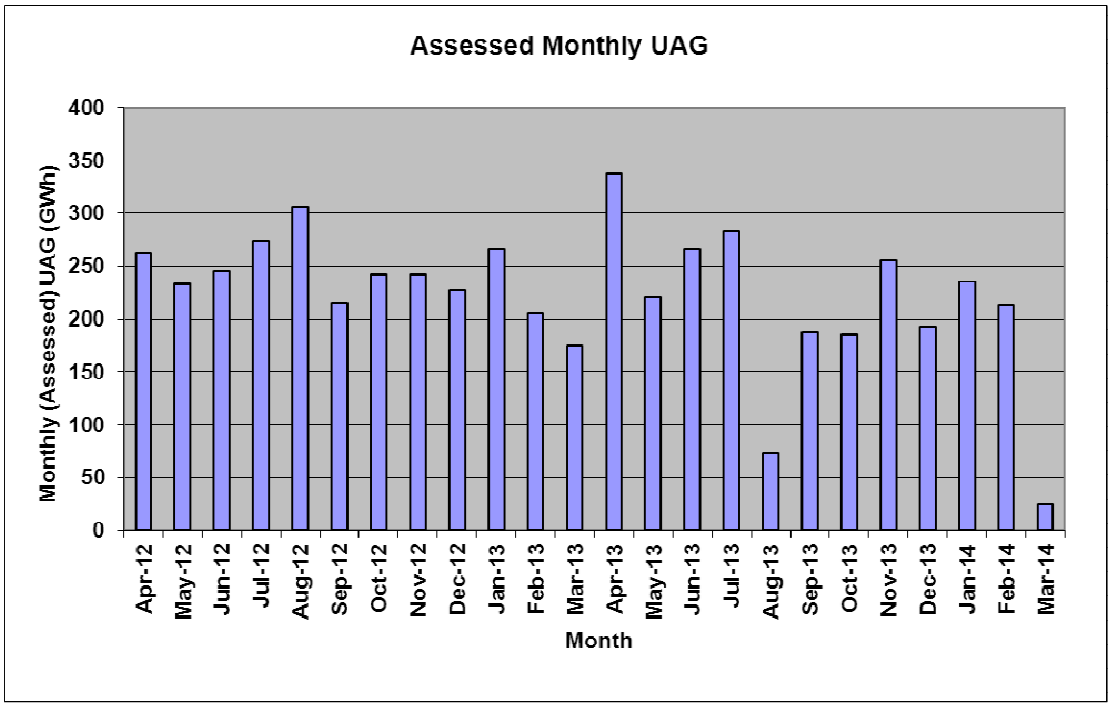

Figure 2: Monthly UAG since April 2012.

The months of August 2013 and March 2014 (provisional) exhibited total monthly UAG levels less than 100 GWh. While initial investigations have not isolated any particular anomalies, the August trend has prompted a review of the current UAG data analysis techniques. The results of this review are presented in Section 1.5.

1.3. Operational Compliance

To meet the ever varying demands of UAG management and to ensure a consistent treatment with related activities, National Grid now co-ordinate all UAG, Shrinkage & Gas Quality activities from a System Operation perspective, through the Operational Compliance team.

The UAG section of this team, undertake the key aspects of the Meter Assurance lifecycle which includes:

- Preventative work related to meter witnessing
- Diagnostic techniques examining underlying UAG trends
- Reconciling meter errors ensuring appropriate allocation of costs across the community

Each of these activities is discussed in detail in the following sections.

1.4. Meter Witnessing

As part of the continued UAG management, National Grid undertakes an annual meter validation witnessing campaign. This activity is an important part of the continuing engagement between National Grid and the meter asset owners across the entire network.

The range and number of sites witnessed since 2009 is presented in Table 2.

Year/Site Type	DNO Offtakes	VLDMC	Terminal/ Storage/Interconnectors	Total
2009/2010	25	8	11	44
2010/2011	17	8	7	32
2011/2012	16	6	9	31
2012/2013	16	13	5	34
2013/2014	10	14	5	29

Table 2: National Grid's Meter witnessing record.

For 2014 the witnessing campaign has been aligned to the calendar year and its scope is presented in Table 3. The choice of sites to be witnessed has been made on a risk score based on the following criteria:

- Meter Error history
- Validation record
- Witness history
- Potential UAG impact

National Grid also complement the witnessing programme by holding regular face to face liaison meetings with the Distribution Network Operators (DNOs). Other forms of appropriate engagement with the diverse set of third party asset owners are also being explored.

Site Type	Planned	Completed
Terminals	6	
Storage	2	1
Interconnectors	3	
VLDMC		
Third Party	6	2
NGGT	3	
DNO Offtakes		
NGGD	6	
WWU	3	
SGN	3	
NGN	4	1
Total	**36**	**4**

Table 3: National Grid's planned and completed meter witnessing campaign for 2014.

The witnessing activity is greatly assisted by the proactive response from all asset owners and the strength of these relationships are highly valued and play an important role in the general husbandry of UAG.

1.5. UAG Data Analysis

Over the past few years, National Grid has continued to develop and refine its UAG data analysis techniques.

This effort has culminated in the development of six data analysis models. Each of these models were described in detail in the October 2013 UAG

Report[1] which also presented the analysis schedule and some indications of their respective capability.

While these techniques examine UAG from different perspectives, they are comparative and statistical in nature. The development of these techniques can be seen as entirely logical when National Grid were analysing UAG trends that were exhibiting rapid changes as a consequence of significant meter errors.

However, as presented in Figure 1, the underlying level of UAG has remained largely stable since 2012. Under these conditions the detection of potential data or measurement anomalies with the respective techniques is difficult to quantify.

To therefore improve National Grid's ongoing UAG management programme, it was felt necessary to conduct an internal review of the set of analysis techniques currently employed. This review is summarised in Table 4.

[1] The October 2013 UAG Report can be found at: http://www2.nationalgrid.com/uk/industry-information/gas-transmission-system-operations/balancing/unaccounted-for-gas

Technique	Review Summary
Statistical Process Control	Pros: Highlights individual days outside +/-3σ. Cons: Gives no indication of source.
CUSUM	Pros: Provides global UAG behaviour. Cons: Data or measurement error rolled up in moving average that masks detection clarity.
Power Station Efficiency Tool (PSET)	Pros: Strong linkage with independent variable (electricity). Cons: Some sites have steam load that require further quantification to ensure compatibility of results.
6 Year Trending	Pros: Provides site specific information. Cons: Very data hungry and a large latency (lag) make it suitable only for very large errors.
Composite Weather Variable	Pros: A reasonable tool for Distribution Network Operators (DNOs) as offtake demands are highly related to temperature. Cons: Model latency of this method still compromises results.
SPSS Data Mining	Pros: Widely used tool by a wide diversity of industrial sectors. Cons: Very complex and difficult to tune with null data sets and large natural UAG volatility.

Table 4: Summary of the UAG data analysis techniques review.

The review has concluded that:

- All the analysis techniques offer detection of potential UAG sources although the latency of the six (6) Year Trending and the CUSUM models make their effectiveness for near term detection very limited.

- The SPC model has very limited applicability as it can only highlight extreme variations in UAG but no further indication of potential source of the issue.

- The complexity of the SPSS data mining tool is making the results difficult to interpret. Further investigation is necessary before any assessment of SPSS's potential in this area of UAG analysis can be made.

- The Power Station Efficiency Tool (PSET) and the Composite Weather Variable (CWV) offer sufficient dynamic response to be of most benefit in effective and timely UAG identification and management.

The review highlighted the need to develop a set of more innovative dynamic techniques that would enable a more immediate assessment of potential UAG sources and complement the existing models.

An initial set of initiatives to address this need have been formulated. These can be summarised as:

- The NTS has a unique set of entry and exit points, each of which operate within a contractual uncertainty. It is proposed to develop an independent assessment of the baseline level of UAG that could be expected from the network operating under normal measurement uncertainties. This independent study will enable National Grid to quantify UAG in terms of this baseline which will assist in the future management of UAG.

- Enhance detection capability with on-line network tools that are already utilised within National Grid. Early indications of the capability of on-line modelling tools suggest that they can offer significant insights into potential UAG sources. This will greatly assist in the proactive engagement that National Grid undertakes with asset meter owners as it will provide near term indicators.

  Initial work with the existing on-line model is being initiated to assess the observed UAG trends of August 2013 and March 2014.

- The development of other mathematical techniques outside the statistical approaches already employed, will explore a range of matrix and dynamical mathematics opportunities. These approaches will be confined to producing a set of techniques that will complement the existing UAG analyses already undertaken.

1.6. Meter Reconciliation

National Grid is obligated to process all NTS related meter error reconciliations for the community to ensure financial equality between the Shrinkage Provider (NGG) and the shipping community. While a defined net UAG position will be subject to meter error detection within the reconciliation window[2], it does provide a further key indicator as to the underlying base UAG trend. Although the reconciliation process is a solely financial readjustment it is still possible to present a consequential net annual UAG energy figure. These are presented for the financial years since 2009 in Table 5.

The net of meter error UAG values indicate that the baseline UAG trend was largely similar throughout the 2009 to 2012 period but then reduced significantly in 2012/13 by 43% from the previous baseline average and continued to reduce in 2013/14 by a further 10%. These baseline UAG assumptions are further supported by the gradual reduction in the total number of meter errors reported per annum since 2009.

[2] On 1st of April 2014, the meter reconciliation will be only permissible within a rolling 3/4 year period (as per UNC 398) down from the previous rolling 4/5 year reconciliation period.

Care must be taken in using the absolute number of meter reconciliations reported each year as a true UAG indicator because a single error can be of significant magnitude. Nevertheless, the reduced volume of meter reconciliations and reduced UAG levels are considered the result of improved asset management.

Year	Annual No of Reported Meter Errors	Assessed UAG (GWh)	Net Reconciled (GWh)	Net UAG (GWh)
2009/2010	81	7551	-3178	4373
2010/2011	48	5996	-1259	4737
2011/2012	52	4737	52	4789
2012/2013	52	2894	-151	2743
2013/2014	33	2472	7	2479

Table 5: UAG net of meter error.

2. Summary

The Operational Compliance team continue to maintain the UAG and Shrinkage activities and since 2012 the underlying levels of NTS UAG have been reducing. While it is not possible to isolate any one unique cause for this reduction it is considered that there are a number of contributing factors. These include the proactive approach of all asset owners to meter husbandry in conjunction with National Grid's concerted witnessing, data analysis and reconciliation activities.

While the current trends are welcome, the variable detection capability of National Grid's existing data analysis techniques has required these to be reviewed. The review has concluded that of the existing set of techniques, the Power Station Efficiency Tool and the Composite Weather Variable offer the

most consistent site specific indicators of potential UAG sources. The SPSS Data Mining capability requires further analysis and tuning before a qualitative assessment can be made. The remaining tools have been developed along logical lines, but with the increasing requirements to have more dynamic indicators, their respective lag and lack of granularity does not provide the clarity required. Subsequently, a set of initiatives to develop alternative techniques that will complement the existing analytical methods has been proposed. These alternative approaches will be developed over the next 12 months.

UAG management is multi-faceted and relies on the widespread expertise of technicians, engineers and managers across the asset owner community. The recent reductions in UAG bear testament to the high levels of commitment by all concerned with gas transmission measurement.

National Grid continues to widen its engagement with all asset owners and will further enhance this activity by providing more opportunities and would always welcome any feedback[3] related to UAG management.

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