Modification Proposal 0355: Alignment of Calorific Value and Wobbe Limits at NTS System Entry Points

CV Shrinkage Analysis Paper by National Grid NTS

Summary

Following discussions with Ofgem, National Grid NTS engaged all Delivery Facility Operators (DFOs) and Storage Facility Operators (SFOs) whose current contractual limits are inside the allowable ranges (i.e. those that would be available for new NTS System Entry Points) for wobbe and Calorific Value (CV). Five DFOs and one SFO accepted National Grid NTS' offer to raise a Modification Proposal to facilitate the amendment of these limits.

The Modification Proposal's aim is to level the playing field at NTS System Entry Points and be more efficient than individual parties raising Modification Proposals in respect of individual terminals rather than necessarily to facilitate any particular DFO bringing gas of a particularly high or low wobbe/ CV specification into the NTS.

In line with previous Modifications 236, 256 and 266 raised in this area, analysis has been conducted to assess whether there is any incremental risk to CV shrinkage as a result of Bacton Seal, Bacton Shell, St Fergus Total, St Fergus Mobil and Burton Point amending their limits. Hole House Farm was excluded from the analysis as the terms of its Storage Connection Agreement result in no material change to CV Shrinkage risk as a result of Proposal 0355. Appendix 1 details the relevant NTS System Entry Points and their current and proposed gas quality specification.

In the event that the relevant DFOs were to deliver gas at their proposed new limits, the analysis outlined below forecasts no material incremental CV shrinkage risk and no CV capping[1] occurring from either the aggregate effect of a particular gas parameter being amended or from an individual NTS System Entry Point.

Methodology

CV shrinkage can arise on the network where gas of a particularly low or high CV enters a Distribution Network which is materially at variance with the flow weighted average CV of all gas entering that network.[2]

The aim of our analysis was to ascertain whether there is likely to be any material change in CV shrinkage risk for the aggregate effect of amending the wobbe lower limit and CV upper limit at the relevant NTS System Entry Points and assess the risk for an individual gas parameter change at each NTS System Entry Point. The wobbe upper limit change proposed for Burton Point and Bacton Seal was excluded from the analysis as the change in the gas parameter was so small resulting in the wobbe upper limit change at Bacton Shell being assessed on an individual basis. There are no changes to any of the relevant NTS System Entry Points CV lower limits. Hole House Farm was excluded from the analysis as the terms of its Storage Connection Agreement (SCA) result in no change to CV Shrinkage risk as a result of Proposal 0355. There is a generic provision within SCAs that provided a storage connection offtakes gas from the NTS which is GS(M)R compliant, National Grid NTS will allow

[1] See Appendix 2 for an explanation of how CV capping arises
[2] See Appendix 2 for an example of Flow Weighted Average CV

that gas to be returned to the system even if the contractual entry provisions are narrower.

The proposed changes to the lower wobbe limits have been included within the analysis as the wobbe number of natural gas is directly proportional to its CV. Therefore any change to the wobbe range may in theory provide for a wider range of CV to enter the network and potentially cause shrinkage costs.

The approach taken was to populate a National Grid simulation tool (Simone) with forecasts of supply/demand flows and supply gas quality information for gas year 2012/2013, informed by the Transporting Britain's Energy (TBE) 2010 process. In line with previous analysis in this area we modelled demand days D1 (i.e.peak), D3, D10, D60, D150 and D300 on the Average Load Duration Curve for this year. The simulation tool then determined CV and volume information in respect of each DN offtake which then populated a shrinkage model. A CV shrinkage forecast for each Local Distribution Zone for each modelled day was thereby determined. Table 1 below provides an example of the output from the CV shrinkage model.

Table 1: Output for the Current CV Shrinkage forecast risk ("Base Case")

LDZ	D1	D3	D10	D60	D150	D300
Scottish	0	0	0	0	0	0
Northern	124,447	-206,468	-69,176	87,241	-73,369	-51,663
North Western	-30,855	81,830	-26,424	75,070	-16,798	0
North Eastern	-78,782	-151,393	191,057	14,590	-20,240	-55,625
East Midlands	179,321	29,495	257,886	-106,993	204,392	36,381
Eastern	232,257	276,355	-130,164	85,300	-177,560	-5,496
South Eastern	0	0	140,797	112,376	-81,871	0
Southern	0	0	0	-229,571	0	0
North Thames	0	0	-239,145	-192,615	141,317	0
South Western	-44,475	168,233	154,383	38,076	67,928	31,802
West Midlands	-142,795	175,494	-158,954	18,451	13,499	-24,926
Wales South	0	0	0	0	0	0
Wales North	0	0	0	0	0	0
TOTAL	239,120	373,545	120,262	-98,075	57,300	-69,529

All of the CV shrinkage values in the above scenario are caused by the effect of rounding daily CVs to one decimal place rather than by CV capping. (CV shrinkage is the difference between measured energy and billed energy, and is positive if the FWACV is rounded down and is negative if the FWACV is rounded up.) This is also true for every other scenario considered. The information was then used to determine an indicative NTS CV shrinkage value for the gas year, derived from the following equation[3]:

$$\sum D_1 + 2 * D_3 + 7 * D_{10} + 50 * D_{60} + 90 * D_{150} + 215 D_{300}$$

By changing the CV values in the simulation tool, this process was used to determine the following:

- the current CV shrinkage forecast risk whereby all terminals deliver at their forecast CVs;

[3] This approach does place significant emphasis on D_{60}, D_{150} and D_{300} but this method is considered appropriate to give an indicative view when comparing a wide range of scenarios.

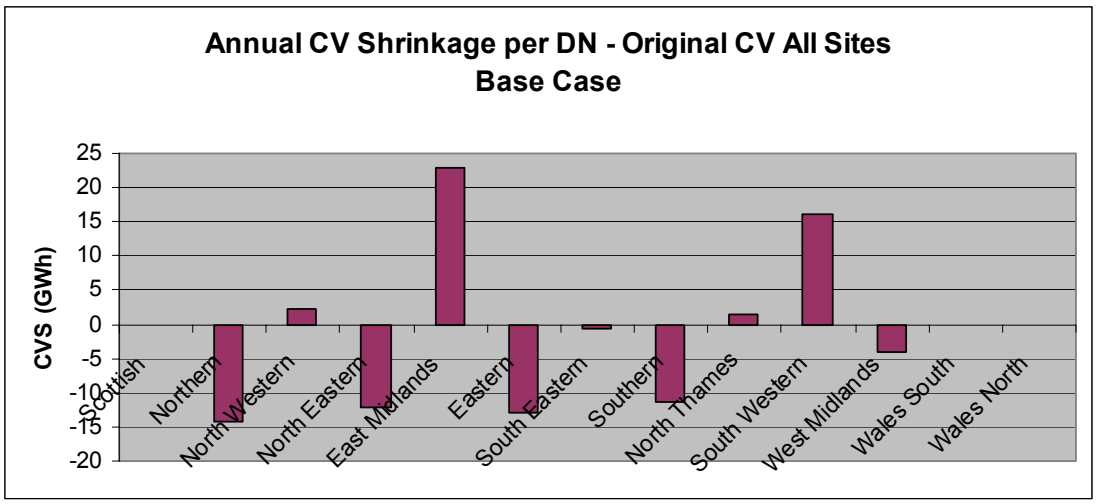
- the current CV shrinkage "theoretical" risk whereby the terminals wishing to amend their gas parameters deliver gas at their relevant current contractual minimum / maximum limits whilst all other terminals deliver at their forecast CVs;
- the CV shrinkage "incremental" risk of implementing Modification Proposal 0355 whereby each terminal delivers gas at it's proposed new limits and all other terminals deliver at their forecast CVs; and
- the aggregate effect of amending the wobbe lower limit and CV upper limit at the relevant NTS System Entry Points.

Results

1. Current CV Shrinkage forecast risk ("Base Case")

The current CV shrinkage forecast risk whereby all terminals deliver at their forecast CVs resulted in a forecast annual CV shrinkage value of -12,867,423 kWh. Chart 1 below presents the annual CV shrinkage forecast by LDZ.

Chart 1



This provides a baseline value for the current CV shrinkage risk and enables a comparison with the CV shrinkage "theoretical" and "incremental" risk.

2. Aggregate effect "Current theoretical" and "Incremental" risk of amending the CV upper limits and Wobbe lower limits

The table 2 below shows the modelled aggregate effect of amending the CV upper limit (for St Fergus Total and St Fergus Mobil) and wobbe lower limit (Bacton Seal, Bacton Shell, St Fergus Total & Burton Point) for the relevant DFOs and includes an absolute (i.e. indexed) change in annual CV shrinkage from the forecast CV shrinkage base case.

Table 2 Aggregate effect "Current theoretical" and "Incremental" risk of amending the CV upper limits and Wobbe lower limits

Scenario	Annual CV shrinkage (kWh)	Absolute (indexed) change from the base position (kWh)
Forecast Base Case: The current CV shrinkage forecast risk whereby all terminals deliver at their forecast CVs	- 12,867,423	0
The current CV shrinkage "theoretical" risk whereby the terminals wishing to amend their **max CV gas** parameter deliver at their **current contractual** whilst all other terminals deliver at their forecast CVs.	- 60,022,200	47,154,777
The CV shrinkage "incremental" risk whereby the terminals deliver gas at the **proposed new max CV limits** and all other terminal deliver at their forecast CV's	- 52,276,254	39,408,831
The current CV shrinkage "theoretical" risk whereby the terminals wishing to amend their **lower wobbe** parameter deliver at their **current contractual** whilst all other terminals deliver at their forecast CVs.	70,091,783	82,959,206
The CV shrinkage "incremental" risk whereby the terminals deliver gas at the **proposed new wobbe limits** and all other terminal deliver at their forecast CVs	5,302,007	18,169,430

3. Current "theoretical" and "incremental" risks for individual NTS System Entry Points

The following table summarises the scenario analysis completed for individual NTS System Entry Points and the impact on CV shrinkage as a result of each gas parameter amendment as proposed in the Modification Proposal while holding all other terminals at their forecast CVs. The third column provides an absolute (indexed) position from the forecast base case for each scenario.

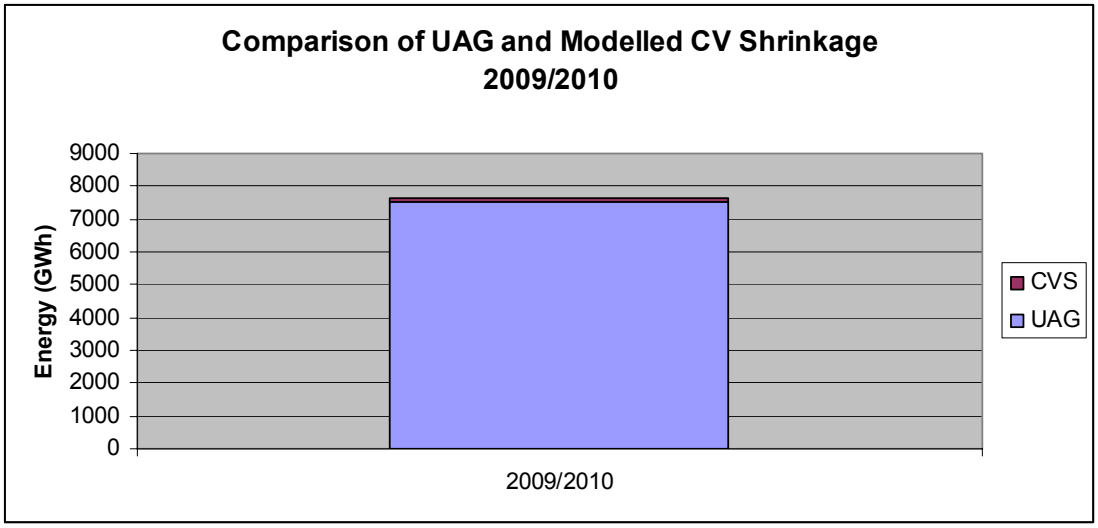
Table 3 Current "theoretical" and "incremental risks for individual NTS system Entry Points

Scenario	Annual CV (kWh)	Absolute Position (kWh)
Original Values All Sites ~ Forecast Base Case	**- 12,867,423**	**0**
St Fergus - MOBIL Current Max CV	**6,070,529**	**18,937,952**
St Fergus - MOBIL New Max CV	**4,449,293**	**17,316,717**
St. Fergus - TOTAL Current Max CV	**5,564,188**	**18,431,611**
St. Fergus - TOTAL New Max CV	**- 24,236,510**	**11,369,086**
Bacton - SHELL Current Min Wobbe	**- 4,387,110**	**8,480,313**
Bacton - SHELL New Min Wobbe	**- 20,058,097**	**7,190,674**
Bacton - SEAL Current Min Wobbe	**- 48,635,634**	**35,768,211**
Bacton - SEAL New Min Wobbe	**- 16,494,043**	**3,626,620**
St Fergus - TOTAL Current Min Wobbe	**- 17,952,734**	**5,085,311**
St Fergus - TOTAL New Min Wobbe	**15,569,989**	**28,437,412**
Burton Point Current Min Wobbe	**- 19,200,095**	**6,332,672**
Burton Point New Min Wobbe	**- 19,200,095**	**6,332,672**
Bacton - SHELL Current Max Wobbe	**- 34,606,944**	**21,739,520**
Bacton - SHELL New Max Wobbe	**- 33,146,817**	**20,279,394**

The results of this analysis forecast material change to CV Shrinkage as a result of amending the current contractual gas parameters to the proposed gas parameter limits. Some of the outcomes both in the 'grouped' analysis (Table 2) and in the individual terminal analysis (Table 3) appear to be counter-intuitive as the application of the proposed new limit results in a decrease in forecast CV shrinkage. This is explained by all forecast CV shrinkage being caused only by rounding not by capping and by the methodology employed to create an annual forecast from 6 modelled days.

The greatest CV shrinkage risk of all the scenarios using the proposed new limit(s) is forecast to arise from St Fergus Total inputting gas at its new limit while holding all others constant at their forecast CVs. As modelled, if this terminal was to deliver at its new proposed minimum wobbe, the incremental CV shrinkage risk from the base case would 28.4GWh which equates to £350k using an annual system average price for Gas Year 2009/10 of 1.23 p/kwh. If this additional 28.4 GWh was added to the 2009/2010 NTS CV shrinkage total of 22 GWh this would still be inside the annual incentive NTS CV shrinkage target of 142 GWh. To provide some context chart 2 compares this volume with the corresponding Unaccounted for Gas (UAG) out turn.

Chart 2



Conclusion

The main conclusions from this analysis are:

1. All scenarios modelled were within the expected annual CV shrinkage ranges and despite the models being run without any mitigation[4], no CV capping was recorded under any of the scenarios modelled.

2. The harmonisation of the gas quality limits at the St Fergus Mobil, Total and Bacton Shell & Seal and Burton Point terminals as proposed by Modification Proposal 0355 is not expected to materially affect the overall NTS CV shrinkage volumes.

[4] In reality CV shrinkage risk is continually monitored and gas flows can be in many cases optimised/re-routed to avoid CV capping occurring.

Appendix 1

The following table lists the NTS System Entry Points and their current and proposed gas quality specification under Modification Proposal 0355.

NTS System Entry Point	Gas Quality Characteristic	Current Specification	Proposed Specification
Hole House Farm	Wobbe Lower Limit	48.14 MJ/m^3	47.2 MJ/m^3
Bacton Seal	Wobbe Lower Limit	48.1 MJ/m^3	47.2 MJ/m^3
Bacton Seal	Wobbe Upper Limit	51.4 MJ/m^3	51.41MJ/m^3
Bacton Shell	Wobbe Lower Limit	48.2 MJ/m^3	47.2 MJ/m^3
Bacton Shell	Wobbe Upper Limit	51.2 MJ/m^3	51.41MJ/m^3
St Fergus Total	Wobbe Lower Limit	48.2 MJ/m^3	47.2 MJ/m^3
St Fergus Total	CV Upper Limit	41.9 MJ/m^3	42.3 MJ/m^3
St Fergus Mobil	CV Upper Limit	41.9 MJ/m^3	42.3 MJ/m^3
Burton Point	Wobbe Lower Limit	48.2 MJ/m^3	47.2 MJ/m^3
Burton Point	Wobbe Upper Limit	51.4 MJ/m^3	51.41 MJ/m^3

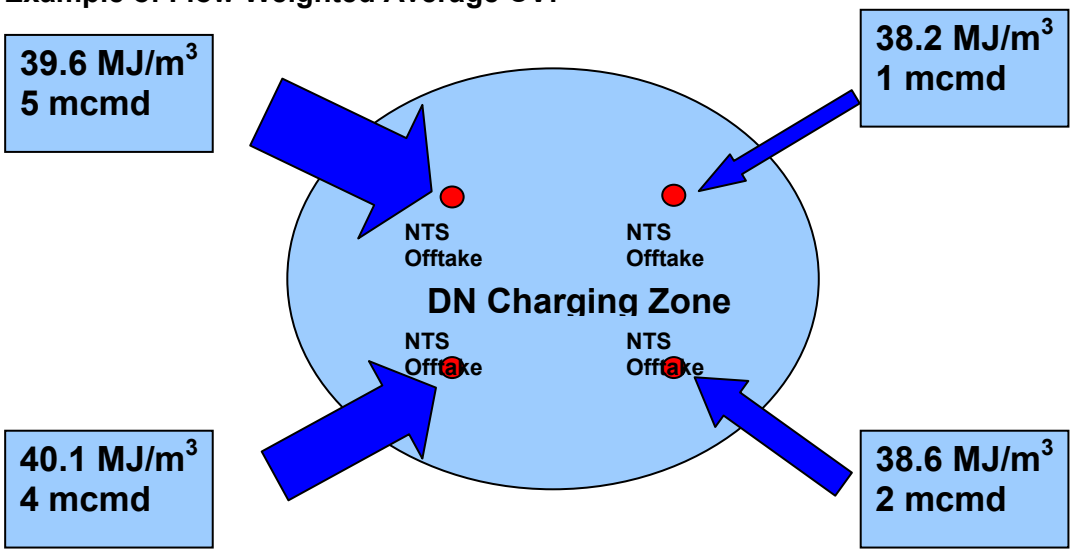
Appendix 2 Flow Weighted Average Calorific Value and CV Capping

The methodology that is currently used for determining the daily billable calorific value (CV) for sites connected within a distribution zone is enshrined within the Gas (Calculation of Thermal Energy) Regulations. In summary, paragraph 4(A) of the Regulations says that the daily CV for each zone shall be the lowest of:

- The flow weighted average CV calculated across all of the inputs into the zone; or
- The average CV measured at any of the individual input points to the zone, plus 1MJ/m^3.

This means that the daily CV used by shippers for billing gas consumers in each zone can be effectively capped at 1MJ/m^3 above the lowest average CV source entering that charging zone, no matter how little the amount (volume) of low CV gas is delivered on that Day. A mismatch can therefore arise between the total amount of energy (kWh) delivered into a zone on a day and the total amount of energy that is deemed to have been offtaken by gas consumers, this difference being "unbilled" energy. Any such "unbilled" energy is procured by National Grid NTS to make up the shortfall in the daily energy balance and is known as CV shrinkage.

Example of Flow Weighted Average CV:



FWACV = $\frac{(39.6 \times 5) + (38.2 \times 1) + (38.6 \times 2) + (40.1 \times 4)}{(5 + 1 + 2 + 4)}$ = 39.5 MJ/m3

FWACV Energy = ((39.5 MJ/m3 x 5 mcmd) + (39.5 MJ/m3x 1 mcmd) + (39.5 MJ/m3x 2 mcmd) + (39.5 MJ/m3x 4 mcmd))/3.6 = 131,666,667 kWh

Lowest source daily CV = 38.2 MJ/m3
Applicable cap = 39.2 MJ/m3

Billable Energy = ((39.2 MJ/m3x 5 mcmd) + (39.2 MJ/m3x 1 mcmd) + (39.2 MJ/m3x 2 mcmd) + (39.2 MJ/m3x 4 mcmd))/3.6 = 130,666,667 kWh

Unbilled Energy (CV Shrinkage) = 1,000,000 kWh