UFG Management and Reconciliation

An Independent Expert Report

June 2007

1. Background

1.1. Terms of Reference

The terms of reference (ToR) under which Creative Energy Consulting (CEC) has been engaged by the Gas Industry Company (GIC) require us to:

1.1 examine the current circumstances in relation to the calculation and allocation of, and attribution of costs associated with, unaccounted-for gas (UFG) on the Maui Development Limited (MDL) and Vector transmission (VT) pipelines;

1.2 address and ascertain the position with respect to various matters (specified below);

1.3 recommend actions as to how the to resolve UFG positions in the future, and how the benefits/costs associated with doing so should be allocated; and

1.4 recommend how any historical (but as yet unaccounted for) UFG positions, if any, are resolved and the benefits/costs associated with them allocated.

The specified matters are:

2.1 how each pipeline operator has dealt with UFG from 1 October 2005 to date;

2.2 how each pipeline operator has physically resolved its UFG position to date;

2.3 how each pipeline operator has financially resolved its UFG position to date;

2.4 how each pipeline operator has allocated the benefits/costs associated with the resolution of its UFG position to date;

2.5 the connection (if any) between the large negative Running Operational Imbalance under the Maui Pipeline Operating Code at Oaonui and UFG on the transmission pipelines;

2.6 the various options for resolving UFG positions on the pipelines that have been discussed in the MDL UFG Work Stream forum, being:

(a) the sale or purchase of excess or deficiency of gas for a Pipeline, with benefits/costs allocated according to contractual rights and obligations;

(b) the periodic distribution of UFG across all receipt and delivery points;

(c) the allocation of UFG to shipper mismatch positions; and

(d) the exchange of gas between the Maui and Vector transmission pipelines to the extent that a negative UFG position on one pipeline is matched in magnitude by a positive UFG position on the other pipeline, to eliminate any common meter error between the two systems.

CEC's advice and recommendations on these matters is set out in this report.

1.2. Approach

CEC is familiar, through previous engagements, with the transportation and balancing arrangements on the MDL and VT pipelines. However, CEC has not been involved in the UFG workstream forum and the options for UFG management discussed there. Therefore, the first activity in this task was to discuss these matters with various stakeholders, listed in section 3.2 below.

CEC has discussed a draft version of this report with GIC and also with MDL, the MDL commercial operator (CO) and VT, prior to finalising it.

1.3. Disclaimer

CEC has developed the analysis and recommendations contained in this report on the basis of an understanding of the economics and practicalities of pipeline transportation and balancing arrangements in NZ and overseas. CEC has not sought to examine or consider the existing legal rights or obligations of pipeline owners or users in relation to historical or future UFG and this report does not express any opinion on whether and to what extent the options considered here are consistent with these legal rights or obligations. Correspondingly, this report does not consider what changes – if any – might be required to the Maui Pipeline Operating Code (MPOC) or corresponding VT agreements in order to implement the various options considered.

1.4. Structure of this Report

This report is structured as follows:

- section 2 undertakes a factual analysis of UFG, both a theoretical examination of its relationship to other imbalance quantities and an empirical review of UFG on the MDL pipeline since the commencement of MDL open access;
- section 3 describes and evaluates option for the future management of UFG on the MDL and VT pipelines;
- section 4 describes and evaluates options for the reconciliation of historical UFG that has accrued on the MDL pipeline to date; and
- section 5 sets out the conclusions and recommendations.

2. Factual Analysis

2.1. Theoretical Analysis

Terminology

This section describes a simple, mathematical treatment of pipeline imbalances. The conventions used are as follows:

The suffix "i" represents welded points

The suffix "j" represents shippers

Variables without suffices represent aggregate quantities across a pipeline

A positive gas flow variable means gas flow *into* a pipeline

Thus, delivery points will generally be associated with negative gas flow variables

UFG is positive where gas has (apparently) disappeared from linepack

Own-use gas is treated as gas delivered to a notional delivery point, for which the Pipeline Operator (PO) is the welded party (WP)

Sign conventions for operational imbalance and mismatch are the same as in the MPOC

The equations hold whatever time period the variables cover (eg one day, one month or a specified historical period), so long as it is the same time period for all variables

The identity symbol "≡" means "is defined to be equal to"

Table 1, below, lists the variables and acronyms used in this report.

Acronym	Meaning	Explanation
ALP	Actual Change in Linepack	The measured change in linepack
AQ_i	Actual Quantity	The actual flow of gas through a welded point i
BQ	Balancing quantity	total amount of gas purchased by PO for balancing gas
COG	cash-out gas	total amount of gas purchased by the PO through the OI or MM cashout process
ELP	Expected Change in Linepack	The change in linepack that would be expected on the basis of metered quantities
EQ_i	Meter Inaccuracy	The difference between the metered and actual gas flows at a welded point
ICP	Interconnection Point	A point of interconnection between the MDL and VT pipelines
MM_j	Mismatch	The difference between nominated receipts and nominated deliveries for a shipper j
MQ_i	Metered Quantity	The metered flow of gas through a welded point i

Acronym	Meaning	Explanation
OI_i	Operational Imbalance	The difference between metered quantity and scheduled quantity at a welded point i
OUG	own-use gas	Gas used in compressors or for other use on the pipeline
PO	Pipeline Operator	The party responsible for pipeline operation: ie the MDL CO or VT
SQ_i	Scheduled Quantity	The scheduled flow of gas through a welded point i
UFG	Unaccounted for Gas	The difference between expected and actual change in linepack
WP	Welded Party	The party responsible for controlling gas flow – and hence OI – at a welded point

Table 1: Acronyms and Terminology

Receipt and Delivery Quantities

At each welded point i on the pipeline, we will define quantities of gas flowing through that point as follows:

AQ_i = actual quantity
MQ_i = metered quantity
SQ_i = scheduled quantity

For each of these variables, a positive quantity represents gas flowing into the pipeline and a negative quantity represents gas flowing out of the pipeline. The actual quantity is never known in practice but, as we shall see, is manifested through UFG and changes in linepack. The following sections will relate these quantities to each other through a series of "imbalance equations".

This report will refer to the difference between the actual and metered quantities as the "meter inaccuracy" or "meter error". Thus:

$$EQ_i = MQ_i - AQ_i$$

where:

EQi is the meter inaccuracy at welded point i

This is a theoretical definition of meter inaccuracy rather than a commercial one. The MPOC treats meters as though they are accurate so long as, when tested, the test discrepancies are within specified tolerances. Thus, from a legal and commercial perspective, meters are assumed "accurate" and meter "errors" or "inaccuracies" are identically zero. However, we know that all meters will have some physical inaccuracy (if they did not, UFG would not arise) and it is this meaning of error or inaccuracy that is used in this report. The existence of these meter inaccuracies does not imply any fault by the relevant welded party or any breach of, or liability under, the MPOC or interconnection agreement.

UFG and changes in linepack

The simplest imbalance equation is that any difference between aggregate and receipt quantities must be reflected in change in linepack[1]: ie

Total actual receipts– total actual deliveries = actual change in linepack

In our terminology above, we can represent this simply as:

$$AQ \equiv \sum_i AQ_i = ALP \qquad (1)$$

where:

ALP is the actual change in linepack

This imbalance equation holds (as do the other equations below) over any timescale. For example, if AQ_i is measured over a day, the equation will hold where ALP is also measured over a day. The equation would similarly hold if both were measured over a week, month or year.

Of course, we do not know the actual gas flows with 100% accuracy. The best estimates that we have are the metered quantities. Based on the metered quantities, we can *expect* some change in linepack.

Total metered receipts – total metered deliveries = expected change in linepack:

In our terminology:

$$MQ \equiv \sum_i MQ_i = ELP \qquad (2)$$

where:

ELP is the expected change in linepack

In this report, we will define unaccounted-for gas to be the difference between the expected and actual changes in linepack[2].

$$UFG \equiv ELP - ALP \qquad (3)$$

where:

UFG is the unaccounted-for gas

[1] assuming, as we do here, that there are no leaks in the pipeline

[2] There is common agreement over this definition, except in relation to the sign convention: ie whether UFG = ELP – ALP or UFG = ALP – ELP. The choice of convention is arbitrary and does not affect the analysis or recommendations.

Note the sign convention that is used. Where linepack does not increase as much as expected (so gas seems to "disappear" from the linepack) ALP is less than ELP and so UFG is positive. Where linepack increases by more than expected (so gas seems to "appear" in the linepack) ALP is greater than ELP and so UFG is negative

Substituting in equations (1) and (2) into (3) we have

$$\begin{aligned} UFG &= MQ - AQ \\ &= \sum_i MQ_i - \sum_i AQ_i \\ &= \sum_i \left(MQ_i - AQ_i\right) \\ &= \sum_i EQ_i \\ &\equiv EQ \end{aligned} \qquad (4)$$

So, UFG is the aggregate of all the meter inaccuracies[3].

Scheduled Quantities and Operational Imbalances

The MDL pipeline operates with operational balancing arrangements (OBAs) at all welded points, meaning that there is also a scheduled quantity – being the sum of all shipper nominated quantities – at each welded point. The operational imbalance at a welded point is defined as:

$$OI_i \equiv MQ_i - SQ_i$$

Where:

OI_i is the operational imbalance at welded point i

Note that because of our sign convention, OI_i is positive:

- at a receipt point where MQ_i is greater than SQ_i; and
- at a delivery point where MQ_i is lower in magnitude (ie less negative) than SQ_i

This is the same as the sign convention that is used in the MPOC. Summing across all welded points, gives

$$OI = MQ - SQ \qquad (5)$$

[3] Indeed, this is sometimes used as the definition of UFG, rather than the definition presented in equation (3). The two definitions are mathematically equivalent

Any difference in aggregate scheduled quantities at receipt points and delivery points must be caused by shipper mismatches: ie

total scheduled receipts – total scheduled deliveries = total of shipper mismatches

or, in our terminology

$$SQ \equiv \sum_i SQ_i = MM \equiv \sum_j MM_j \quad (6)$$

where

MM_j is the mismatch of shipper j
MM is the aggregate of all shipper mismatches

Appendix 1 shows how, using the equations above, UFG can be expressed in terms of ALP, OI and MM as follows:

$$UFG = OI + MM - ALP \quad (7)$$

Equation (7) is a useful equation as it expresses UFG in terms of things that we know (as opposed to things that we don't know directly, such as AQ) and that are attributed by OATIS to individual shippers and welded parties. We will refer to this equation as "the imbalance equation". A special case of this equation is where shipper mismatches and ALP are zero, meaning that:

$$UFG = OI \quad (8)$$

So, in this case, any UFG that has accrued over an extended period must be manifested as OI at one or more welded points. This is pertinent to point 2.5 of the ToR, since it shows that UFG and OI are mathematically related. However, by itself, it does not explain why all of this "offsetting" OI has occurred at Oaonui. This is discussed further below.

Equation (8) does not mean that WPs – through their aggregate OI – have caused or created UFG. On the contrary, equation (4) above showed that UFG is caused by meter inaccuracies. This UFG then causes an imbalance, which must be manifested in ALP, MM, OI or a combination of these. So, it is truer to say that UFG causes OI.

Pipeline balancing

The ToR requires us to ascertain how the POs have physically and financially "resolved" the UFG position to date. This section considers the actions that a PO may take to "balance the pipeline": ie to ensure that the ALP over a period remains within specified operational limits. The following section considers how these balancing "tools" have been applied historically in relation to UFG.

The balancing tools available under the MPOC are:

- *imbalance notices*: requiring a WP or shipper to take actions to reduce the absolute level of their OI or MM, respectively;
- *cash-out*: buying or selling (as the case may be) some of the outstanding OI or MM from the WP or shipper, respectively; and
- *balancing gas*: requesting "balancing gas" from a shipper or WP.

Imbalance Notices

Imbalance notices can be issued by the MDL CO under the MPOC when a shipper's MM is non-zero or when a WPs OI is outside a specified tolerance. These actions will generally have the effect of reducing the absolute levels of MM and OI. By re-arranging the imbalance equation to give:

$$ALP = OI + MM - UFG \qquad (9)$$

we can see that this will cause ALP to approximate minus UFG. So, these actions will be effective if UFG is small but will be counterproductive if UFG is large: ie greater than ALP operational limits. Therefore, in the presence of significant UFG, other balancing tools are needed.

Cash-out

If shippers or WPs do not take action to reduce the levels of their imbalances, MDL CO has the option under the MPOC to buy or sell (in the case of positive or negative imbalances, respectively) some of the imbalance. This cashout is simply a change in gas title; it does not change the gas flows into or out of the pipeline and so does not directly affect linepack.

Our imbalance equation (9) must now be changed to reflect the possibility of OI or MM reducing with no corresponding change to ALP. The modified imbalance equation is:

$$ALP = OI + MM - UFG + COG \qquad (10)$$

where:

COG is the aggregate amount of gas purchased[4] by the PO through cash-out

So, for example, a cashout purchase of 100TJ may reduce OI (say) by 100TJ but will increase COG by 100TJ, leaving ALP unchanged.

Balancing Gas

Balancing gas is gas requested by the PO, over and above the scheduled quantity. A balancing request may be a "call" or a "put", being requests for additional gas (ie higher injection or lower withdrawal) or reduced gas (ie lower injection or higher withdrawal), respectively.

[4] or sold by the PO if COG is negative

The balancing gas request may or may not be "cashed": ie bought or sold outright by the PO[5]. If it is not cashed, the effect will be to increase (for calls) or decrease (for puts) the level of OI or MM[6] held by the party that responded to the request: with a corresponding change to the aggregate OI or MM for the pipeline. If, on the other hand, the balancing request is cashed, OI and MM levels will be unchanged and instead the COG amount will change by the amount of the balancing request.

A WP who provides balancing gas that is not cashed would obtain an assurance that it would not receive an imbalance notice in respect of OI that has accrued as a consequence of the provision of this balancing gas.

Referring back to equation (10), we can see that either type of balancing request will have the same effect on ALP. For example, an uncashed call for 10TJ of balancing gas will increase OI by 10 and so increase ALP by 10. Alternatively, a cashed call for 10TJ will increase COG by 10 and so, similarly, increase ALP by 10.

Managing UFG

Over an extended period, the allowable variation in ALP will be small compared to the size of UFG. Therefore, we can re-arrange equation (10) as:

$$UFG \approx OI + MM + COG \qquad (11)$$

where:

the symbol "≈" means "is approximately equal to"

So, in order to manage UFG[7] a PO must:

- issue uncashed balancing requests, in order that cumulative OI (or, for VT pipelines, cumulative MM) approximates to cumulative UFG;
- issue cashed balancing requests, so that COG in aggregate approximates to cumulative UFG; or
- issue a combination of uncashed and cashed balancing requests such that the sum of OI and COG approximates to cumulative UFG.

VT has the additional option of drawing on OI at ICPs to manage imbalances. In effect, this means VT holding a "mismatch" on the VT pipeline in its own right, and so is a special case of the first bullet point above.

[5] the MDL CO refers to uncashed balancing requests as "operational balancing actions" and cashed balancing requests as "secondary balancing actions"

[6] For simplicity (and reflecting current practice) we shall assume that such requests are only made to WPs on the MDL pipeline and to shippers on the VT pipeline

[7] Or, strictly speaking, to maintain ALP within its operational limits in the face of UFG

Conclusions

Based on this theoretical analysis, we can reach the following theoretical conclusions:

- UFG is created as a result of physical meter inaccuracies: differences between metered gas flow and actual physical gas flow;
- in the absence of offsetting actions by the PO, UFG will be manifested in imbalances: changes in linepack, shipper mismatch, welded party OI, or a combination of these;
- in order to manage linepack over the medium-term, the PO must issue balancing requests that, in aggregate, approximate to the accumulated UFG;
- balancing requests that are not cashed out will give rise to running OI or running MM for the WPs or shippers, respectively, that respond to these requests; and
- to maintain imbalances (ALP, MM and OI) close to zero, the PO must purchase – through cash-out activities - an amount of gas approximately equal to the accumulated UFG.

In relation to the last point, we will refer to any difference between UFG and gas purchased by the PO as "outstanding UFG": ie

$$OUFG \equiv UFG - COG$$

where

OUFG is outstanding UFG

Equation (11) can now be rewritten as:

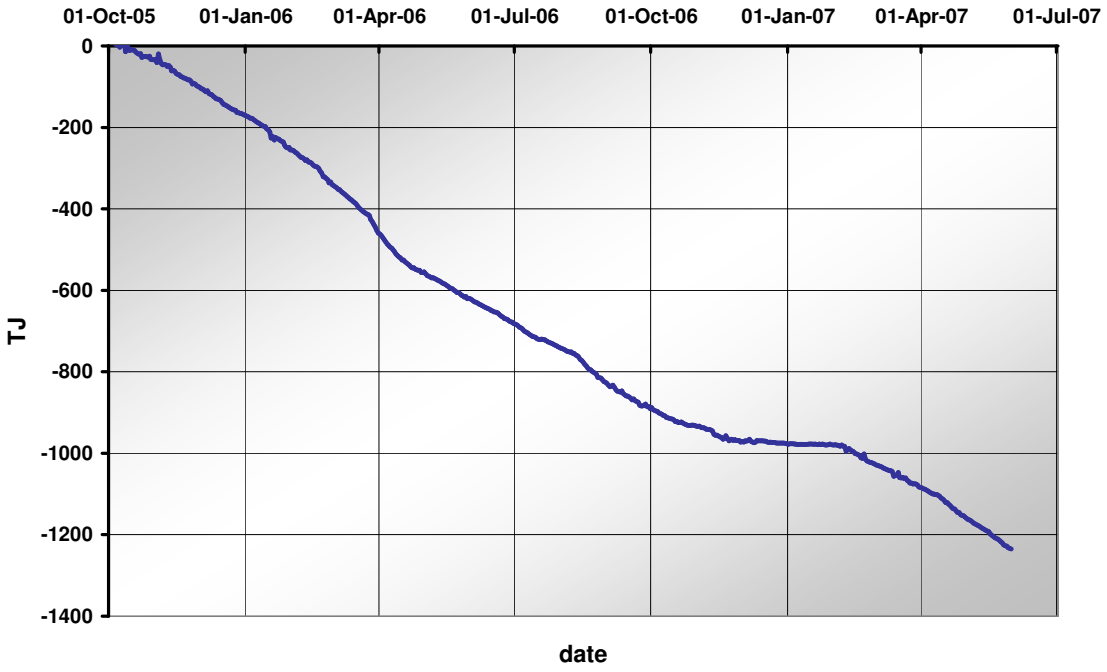
$$OUFG \approx OI + MM \qquad (12)$$

So, to bring OI and MM to zero, a PO must bring OUFG to zero.

2.2. Empirical Analysis

This section analyses the actual UFG that has arisen on the MDL pipeline and, pursuant to points 2.1 to 2.4 of the terms of reference, how each PO has managed it.

Figure 1: Cumulative UFG since 1st October 2005



Historical UFG

Daily UFG information has been provided by the MDL CO. Figure 1 shows the accumulated UFG position since early open access. The cumulative UFG as at 31st May 2007 is around 1.25 PJ.

It is clear that UFG over this historical period has a strong negative bias. However, within this, daily UFG has been quite volatile and is often positive. Figure 2 is a histogram of UFG expressed as a percentage of the daily delivery quantity. There are 10 outliers not shown on the graph: 7 negative and 3 positive.

Much of the volatility of daily UFG is quickly smoothed out through a high-pass filter such as a moving average. Figure 3 shows daily UFG and weekly and monthly moving averages for the historical period. A significant proportion of the daily variation may be due to errors in linepack calculation, as discussed below.

Figure 2: Frequency of daily UFG

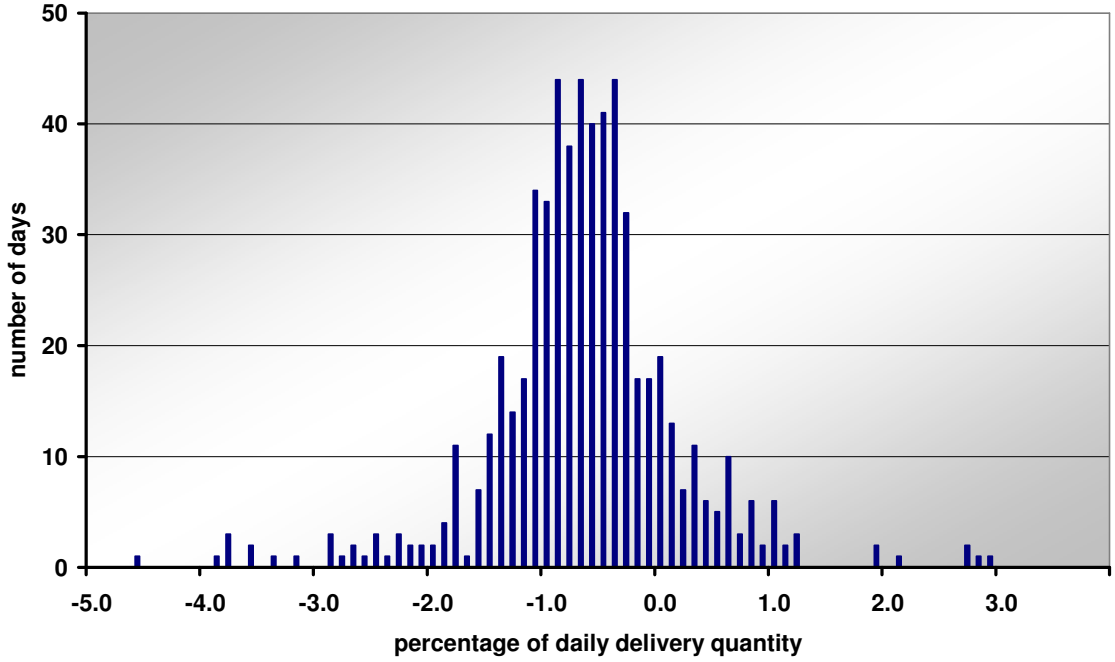
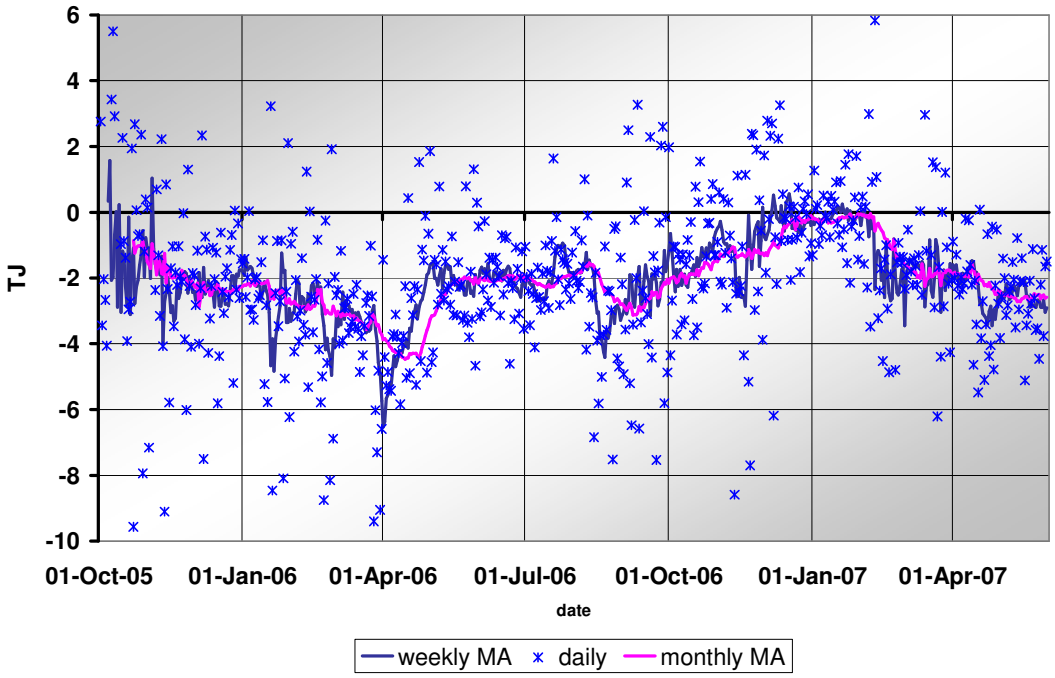


Figure 3: Daily, Weekly and Monthly UFG



CEC has not received any historical information relating to UFG on VT pipelines.

Historical Actions to Manage UFG

Given the magnitudes of the historical UFG position, POs on both pipelines have needed to take balancing actions.

MDL has managed UFG in two ways.

Firstly – and primarily – it has issued frequent, uncashed balancing puts to the WP at Oaonui. This is the reason why the running OI at Oaonui is highly negative, of a similar order to the UFG level[8].

When making balancing requests, the MDL CO's sole purpose is to manage LP. It does not consider explicitly whether the linepack variation is caused by UFG, OI or MM. Indeed, this can only be known after the day, when meters are read.

We understand that the intention is for the MDL CO to eventually issue reverse balancing requests to Oaonui, to allow the OI to return towards zero[9]. In a sense, the PO has lent gas to the Oaonui WP and will require at some point that this gas is returned.

Secondly, since the end of May, the MDL CO no longer purchases gas for its own use: ie there is no scheduled quantity of gas for delivery at the Mokau compressor. This is equivalent to the PO making a cashed[10] balancing put to itself as the WP at Mokau. This has the effect of making COG more negative and so reducing slightly the amount of negative outstanding UFG.

The cumulative effect of this secondary action to date is likely to be limited, since own-use gas averages less than 1TJ/day. Therefore, the currently outstanding UFG is likely to be upwards of 1.25PJ.

VT has adopted a different approach to managing UFG. It has taken action to buy or sell quantities of balancing gas equal to the UFG position. This has been through competitive tender processes. Initially, this was done ex post, based on "clearing" the historical accumulated levels of UFG. More recently, VT has forecast future levels of UFG and bought or sold balancing gas to clear this forecast position over the forecast period.

Thus, on the VT pipeline, COG should be roughly equal to (with opposite sign) UFG and so there will be only a relatively small amount of outstanding UFG.

[8] We do not know the exact quantity of balancing requests made and are only anecdotally aware of the current OI levels

[9] To do this, the MDL CO would need to make balancing puts (cashed or non-cashed) to other parties.

[10] at zero price

Overpressure Events

One of the triggers for reviewing the UFG issue was the overpressure situation that occurred at various times in November and December 2006, where linepack reached its upper operational limit and the MDL operators were required to curtail receipt nominations. Although it is not specifically referred to in the ToR, it may be helpful to consider the relationship between UFG and overpressure problems in the light of the theoretical and empirical analysis above.

Firstly, it has been demonstrated that, other things being equal, an increase in the cumulative negative UFG position will cause linepack to increase. Therefore, unless it is addressed through balancing actions, a persistently negative UFG amount will create overpressure problems.

However, as described above, the MDL CO *has* been making uncashed balancing requests to offset the impact of UFG. Indeed, the overpressure problems first arose in November 2006 when the cumulative UFG position was already approaching 1 PJ. UFG had been accumulating prior to that date without any overpressure problems arising.

Secondly, daily UFG has been relatively low, averaging around -2TJ. This compares with aggregate daily OI limits across the MDL pipeline of around 30TJ.[11] So UFG would only become a balancing problem comparable to that associated with WP imbalances if it was allowed to accumulate, unmanaged, for 15 days or so. With daily management of UFG, there is no reason why UFG should create balancing problems.

Thirdly, there is nothing in the historical UFG outcomes that would suggest that UFG would first trigger overpressure problems in November 2006. Indeed, UFG in the last months of 2006 seemed to be on an increasing trend (see figure 3) which, other things being equal, should actually reduce somewhat the likelihood of overpressure problems.

Therefore, there is no reason, *prima facie*, to suppose that persistent negative UFG and the mechanism that the MDL CO has been using to manage imbalances would give rise the overpressure problems seen. However, for a complete explanation of the overpressure problems, and to be able to definitively rule out UFG as a contributory factor, we would need to examine all of the balancing requests – and the response to these requests – issued by the MDL CO. This is beyond the scope of this report.

[11] Based on the minimum tolerances set out in Schedule 7 of the MPOC

3. Future UFG Management

3.1. Overview

This section addresses clause 1.3 of the ToR, that requires the independent expert to:

> "recommend actions as to how to resolve UFG positions in the future and how the benefits/costs associated with doing so should be allocated"

For the purposes of this section, it is assumed that:

- the historical UFG position has been satisfactorily resolved: ie the future mechanism begins with a "clean sheet" of zero accumulated UFG; and
- legal issues do not arise: ie pipeline codes, agreements and contracts are amended as necessary to reflect the new arrangements.

Potential options have been identified from the following sources:

- the terms of reference;
- stakeholder interviews; and
- international practice.

The following section discusses this identification process. The identified options are then described and considered in turn.

3.2. Identification of Options

Terms of Reference

Clause 2.6 of the ToR requires that the independent expert addresses:

> "the various options for resolving UFG positions on the pipelines that have been discussed in the MDL UFG workstream forum, being:
>
> a. the sale or purchase of excess or deficiency of gas for a Pipeline, with benefits/costs allocated according to contractual rights and obligations;
> b. the periodic distribution of UFG across all receipt and delivery points;
> c. the allocation of UFG to shipper mismatch positions; and
> d. the exchange of gas between the Maui and Vector transmission pipelines to the extent that a negative UFG position on one pipeline is matched in magnitude by a positive UFG position on the other pipeline, to eliminate any common meter error between the two systems."

These options are covered in this report as follows:

- option (a) is the "PO Trading" option, discussed in section 3.3;
- option (b) is the "Meter Reading Adjustment" option discussed in section 3.4;
- option (c) is the "Mismatch Adjustment" option discussed in section 3.5; and
- option (d) is part of the mechanism for the "Combined Pipeline Operations" option discussed in section 3.6.

Stakeholder Interviews

Interviews have been held with representatives of the following stakeholders:

- Vector Transmission
- MDL Commercial Operator
- Vector Wholesale
- Contact Energy
- Genesis Power
- Nova Gas
- Shell

This was an informal process to quickly obtain the views and perspectives of a range of stakeholders. It was not, and was not intended to be, a formal consultation process and so not all stakeholders were interviewed.

The four options listed in the ToR were raised and discussed in the interviews. Furthermore, the concept of the two pipelines "exchanging gas" was generalised to consider mechanism for managing UFG as a single quantity across all pipelines, rather than managing UFG on each pipeline separately. This "combined pipeline operations" option is discussed in section 3.6.

Other options were raised in these interviews.

- For the PO to use the (negative) UFG to supply its own-use gas needs: eg to fuel compressors: this is considered as a component of the "PO Trading Option".
- For the PO to combine trading of UFG with trading of other balancing gas: this is also covered in the PO Trading option.
- To improve processes to identify and correct meter errors: whilst this may potentially reduce the magnitude of UFG, there will still be some amount of UFG arising even when all meters are operating within specified tolerances. Indeed, there is no suggestion that the historical UFG is a result of meters operating outside of tolerances. Therefore, this is not seen as a solution to the treatment of UFG and is not considered further.
- To improve the accuracy of linepack measurement: this may reduce the variability of "apparent" UFG from day to day, but would not materially affect the level of UFG accumulated over a period of a week or more.

Therefore, this is also not seen as a solution, although it could help to improve the effectiveness of other options.

International Practice

Some approaches to UFG on overseas gas pipelines have been reviewed. This research is not intended to be exhaustive, but is instead used another vehicle for identifying possible approaches to UFG.

UK and Ireland

In these markets, UFG is combined with OUG to form "shrinkage" gas. Shrinkage must be purchased by the PO through the wholesale gas market. Monthly purchase costs are allocated to shippers pro rata to monthly deliveries. Note that these markets have active wholesale gas spot markets where liquidity is provided and prices are revealed.

Australia

On some pipelines, for example the Moomba to Sydney pipeline, shippers are required to provide, at their own cost, an amount of "system use" gas (which covers UFG plus OUG) which the PO notifies them of monthly. Generally, system use gas is allocated *pro rata* to deliveries.

US

Pipeline tariffs in the US typically specify a "retainage" factor which is a fixed UFG factor and which is applied to metered delivery quantities. Thus, a shipper's mismatch will be its receipts minus deliveries minus retainage.

Options Considered

Based on this assessment, 6 options are considered, as shown in the table below

	Separate Pipeline Operations	**Combined Pipeline Operations**
PO Trading	Option 1	Option 1A
Meter Reading Adjustment	Option 2	Option 2A
Mismatch Adjustment	Option 3	Option 3A

These are described in the sections below, together with a consideration of the issues arising in each option and how they might be resolved.

3.3. Option 1: PO Trading

Description

This option is similar to the current practice of VT. The main features are as follows:

- the PO (MDL CO or VT CO) would periodically buy or sell an amount of balancing gas so as to maintain its outstanding UFG position (the total accumulated UFG minus the total amount of gas purchased) reasonably close to zero;
- the PO would arrange regular competitive tenders with the aim of maximising the value of gas sold (or minimising the cost of gas purchased) whilst minimising the transaction costs associated with managing the tender;
- all registered shippers would be eligible to tender to supply or receive the gas; other parties (eg producers) could not sell the gas directly but could do so indirectly through a shipper;
- balancing gas would be provided or received at a specified welded point;
- any costs or revenues associated with MDL UFG trades would be passed through to shippers by adjusting shipper tariffs; and
- the allocation of costs or revenues associated with VT trades would be a matter for VT in accordance with its regulatory obligations.

Issues arising under this option are discussed below.

Transaction Costs

There will be some costs associated with preparing, overseeing and participating in the tendering process. Costs will be incurred by the PO and participating shippers.

These costs may be significant initially, as standard tendering and contractual arrangements were prepared and then modified in the light of experience. However, once this process had stabilised, the ongoing costs should be quite moderate. It may simply be a matter of the PO posting quantities offered or required and shippers posting bid or offer quantities and prices.

Loss of Value

A related concern is the loss of value of the gas itself: ie as a result of deficiencies in its marketing arrangements, the PO may receive less for gas sales or pay more for gas purchases than the ideal. This may be because the PO is financially disinterested in the value received as it simply passes this value onto shippers.

This issue is partly a “zero-sum game”. For example, if the PO does not obtain the best sales price, it may be that one shipper has gained value by acquiring cheap gas, at the expense of the PO – and, eventually, other shippers – who receive less value. However, there may also be “dead-weight loss” where the PO markets the gas inefficiently. For example, the PO may unnecessarily require that an equal amount of gas is purchased

for each day in the month, which might dissuade shippers who were seeking to buy gas for weekdays only.

A particular concern at present is that the current gas wholesale market is a buyer's market and additional sales by the PO could further depress this market. However, as UFG is likely to be less than 1% of gas deliveries, by itself it should have limited effect. Indeed, this should be seen in the context that the negative UFG has already *lifted* the market, by requiring producers to deliver an additional 1% of gas – or consumers to use 1% less gas. So the sale just brings the market back to where it would have been had all meters been physically accurate.

Loss of value concerns are not restricted to UFG trading. Similar concerns could be expressed in relation to all of a PO's operational costs. However, by expanding the scope of PO operations, this option potentially exacerbates these concerns.

Double Counting of UFG

Meter inaccuracies at an interconnection point (ICP) between two pipelines will lead to equal and opposite UFG on the two connecting pipelines. Under the PO Trading option, this will lead to gas sales and purchases by the two POs whose net effect is zero.

This means that transaction costs will be incurred – and value may be potentially lost – which could potentially be avoided if the offsetting UFGs had first been netted off. It also creates an opportunity for an "arbitrageur" to buy from one PO, sell to the other, and then pocket the price difference.

To reduce transaction costs and possible loss of value, it may be appropriate to synchronise the MDL and VT tender processes, to make the arbitrage option explicit and (hopefully) remove much of the arbitrage potential. Alternatively, the double counting can be explicitly excluded by adopting the "Combined Pipeline Operations" option 1A, discussed further in section 3.6, below.

Value Transfer from WPs to Shippers

Although the source, or sink, of the UFG cannot be identified, it must have arisen due to physical meter inaccuracies at one or more welded points. For example, if a producer's meter was running "slow" to the extent that it only read 99TJ for each 100TJ of gas injected, this would mean that the producer was not being paid for 1TJ out of each 100TJ produced. The producer's loss becomes the POs' or shippers' gain in this option.

In general, where there is negative UFG, there is a corresponding value transfer from WPs to POs and shippers, compared to the hypothetical counterfactual where all meters had perfect physical accuracy. For positive UFG, the effect would be reversed and the value transfer would be from shippers to welded parties.

In fact, all of the options must involve some value transfer between parties compared to the hypothetical counterfactual. For some options, the transfer will be between classes of participant and in others it will be between participants within a class. It is not clear that there should be greater concern over the former outcome compared to the latter.

Ring-fencing Concerns

Given that the POs have shipper affiliates, concerns may arise that the PO may be able to discriminate in favour of its affiliates in the tender process. This concern could be addressed through establishing appropriate ring-fencing arrangements.

Synergies with Balancing and Own-use gas

POs already have to purchase own-use gas and to trade in balancing gas to manage linepack in the face of shippers and WP imbalances, even in the absence of UFG. So, the PO trading approach could be seen as supplementing or complementing this existing activity rather than creating a new activity. In this sense, there may be synergies in having the PO responsible for all three of these "imbalances".

For example, the MDL CO is currently "supplying" the Mokau compressor with UFG, which means it neither has to procure the own-use gas nor dispose of the UFG, saving in transaction costs and avoiding potential loss of value.

On the other hand, the MPOC and the VT arrangements require that balancing costs are quarantined from the other costs, so there will still be a need to account for these separately.

IT Costs

OATIS already provides for POs to buy and sell balancing gas and the trading of UFG should just be an extension of this. Separately accounting for the value of UFG trades may be an additional functional requirement, but this could be done "off-line" through a spreadsheet or similar application. Therefore, this option would not appear to create significant additional IT costs.

Summary

The issues arising in this option are primarily commercial rather than practical: in particular, whether some inefficiency results from having the PO responsible for commercial activity in which it may have no direct financial stake. These concerns are hypothetical in the sense that it is not possible to quantity how much – if any – value is lost; or, conversely, how much extra value might be obtained by an appropriately incentivised trader.

3.4. Option 2: Meter Reading Adjustment

Description of Option

This option involves adjusting the metered quantities[12] at each welded point in a way which causes total receipt quantities to equate to total delivery quantities and "eliminates" UFG: or, more accurately, allocates the UFG across all welded points.

The metered quantities are adjusted by a "UFG factor", determined by the formula:

$$K = UFG \Big/ \sum_i abs(MQ_i)$$

where:

ABS(x) means the absolute value of x, so that the denominator is the sum of receipts and deliveries.

K is the UFG factor

For receipt points, "deemed" quantities are calculated by adjusted the meter readings according to the formula:

$$DQ_i \equiv MQ_i * (1 - K)$$

where

DQ_i is the "deemed" (ie adjusted) metered quantity

For delivery points, on the other hand:

$$DQ_i \equiv MQ_i * (1 + K)$$

Appendix 2 shows that substituting for DQ in place of MQ in our imbalance equation allows UFG to be eliminated: ie

$$ALP = DOI + MM + COG$$

Where:

DOI is the "deemed operational imbalance" based on comparing the deemed quantities rather than metered quantities to the scheduled quantities.

[12] Note that the adjustment to meter readings is entirely notional. There are no changes made to the meters themselves.

Thus, the adjustment eliminates UFG as a source of imbalance on the pipeline. Instead, UFG, through the adjustment process, creates incremental imbalances at each welded point and these must be managed individually by WPs.

Issues arising under this option are discussed below.

UFG impact remains with welded parties

This solution has some intuitive appeal[13] in the sense that UFG is "caused" by welded parties due to meter inaccuracies and it is welded parties who bear the impact of UFG. Shippers and the PO, who are not involved in the creation of UFG, are also not affected by it.

Indeed, it is a fundamental economic principle that economic efficiency is promoted by ensuring that parties bear the costs associated with their behaviour. Where they do not, "moral hazard" arises, where a party behaves in a way which is beneficial to itself but creates costs which are borne by others. The MPOC arrangements seek to avoid moral hazard arising in other areas: for example, by ensuring that a welded party bears the cost of any damage to other pipeline users caused by its excess negative operational imbalance.

However, the solution proposed here does not allocate costs on individual WPs based on their physically metering inaccuracies, because, of course, these are not known. Instead, it "smears" the costs across WPs as a class. Thus, where UFG was in fact caused by physical metering inaccuracy at a single welded point, the costs are nevertheless spread across all welded points. The WP who is theoretically "at fault" may bear only a small portion of the costs that it "created".

Furthermore, moral hazard in relation to metering accuracy is already addressed in the MPOC by specifying standards for metering accuracy and ensuring that meters are independently tested against these standards. A WP whose meter is physically inaccurate but which is still within the accuracy standard is not guilty of bad behaviour but is simply the unwitting victim of unavoidable metering uncertainties.

For these reasons, and despite its intuitive appeal, there is no reason to expect that allocating UFG to welded parties will be better at promoting metering accuracy than the other options considered.

Uncertainty in Operational Imbalance

This option creates some additional uncertainties and risks for WPs as a result of its impact on their OI levels. For example, suppose that UFG on a day is 1% of total deliveries, meaning that a welded point will typically be allocated UFG which is around 0.5%[14] of its daily gas flow. With MPOC limits for OI (both daily and running limits) being as low as 3% for some welded points, the OI allocation is likely to materially affect the risk that OI limits are exceeded. Conversely, if uncertainty over daily UFG levels is around +/-1%, a welded party with OI limits of +/-3% of deliveries would need to ensure that its OI on a day was within a band of +/-2.5% to have certainty that the metering adjustment did not cause its DOI to exceed the MPOC limits.

[13] Some stakeholders have referred to this option as "logical" and other options as "illogical"
[14] recalling that the adjustment factor is the UFG divided by the sum of receipts *and* deliveries.

If UFG on a day is 1% of daily deliveries, over a period of a week it might be as much as 7% of daily deliveries. So, a metering adjustment made weekly in arrears, would almost certainly cause DOI to breach MPOC limits at some welded points. For this reason, the metering adjustment should be undertaken daily, in arrears, so as to minimise the OI uncertainty.

Linepack Calculation Uncertainty

It should be recalled from section 2.1, that UFG can only be calculated by reference to changes in linepack. If UFG is to be calculated daily then linepack must be measured daily.

Figure 3, above, showed how much of the daily volatility in UFG averages out over a week. This suggests that errors in linepack measurement are to blame for at least part of this volatility[15].

Such measurement errors are unlikely to have any operational impact, as they are much less than the allowable operational variation in linepack. However, they may materially impact WPs under this option, by adding to the uncertainties in DOI discussed in the previous section.

Although this has not been investigated in this report, it may be possible in principle to design a filtering mechanism[16] to reduce the impact of linepack calculation error, albeit at the expense of creating some further complexity in IT systems. It may also be possible to improve the accuracy of the calculation, although this is likely to have some associated cost.

Although we have not seen historical daily UFG quantities for the VT pipelines, daily volatility induced in part by linepack measurement error is similarly likely to be an issue under this option.

Retrospective Meter Adjustment

The MPOC requires that, where a meter is tested and found to have measurement errors outside the specified standards, it must be recalibrated and the meter readings adjusted accordingly and retrospectively up to a maximum of 60 days, depending upon when the meter was last previously tested[17].

Because UFG depends upon meter readings, this would cause UFG to change retrospectively over the same period. If the methodology described above is strictly applied, meter readings – and hence DOI – would need to be recalculated retrospectively, forcing a step change in running OI for all WPs, causing many of them to

[15] This is because the effect of linepack measurement error on UFG quickly cancels out. If linepack is underestimated on a day, this makes it appear that there has been a sharp reduction in linepack and so UFG will be calculated to be positive. However, it will also make it appear that there is then a sharp *increase* in linepack on the following day, creating negative UFG. So, the cumulative impact on UFG of this linepack measurement error over two days will be zero, as the two daily impacts will cancel each other out.

[16] eg a Kalman filter

[17] see MPOC schedule 1, clause 4.3

be outside of their tolerances[18] and exposing them to the risk of being cashed-out by the PO.

Using a Fixed UFG Factor

The previous 3 issues arise because the UFG factor is calculated daily in arrears. These issues can be avoided or mitigated if, instead, the UFG factor is fixed in advance of the gas day. For example, if the UFG factor is set in advance to be -0.5% (say) for the next calendar month, then there is no uncertainty created by variations in actual UFG, linepack calculation error or retrospective meter adjustment.

We have used the historical daily MDL UFG numbers to develop an approach which uses a fixed UFG factor which is reset at the start of each calendar month. For the first month (October 2005), the UFG factor is set at -0.5%. Subsequently, the monthly UFG factor is based on the actual UFG factor[19] for the previous month, plus an additional factor to recover a proportion[20] of the cumulative outstanding UFG to date. The results of this approach are presented in figure 4.

The graph shows that the cumulative outstanding UFG varies between around +/40TJ. This is still substantial in the context of operational linepack limits[21] and so would need to be managed by the PO using balancing requests[22].

[18] Such a problem exists currently for the WP whose meter has been retrospectively adjusted but not at other welded points...

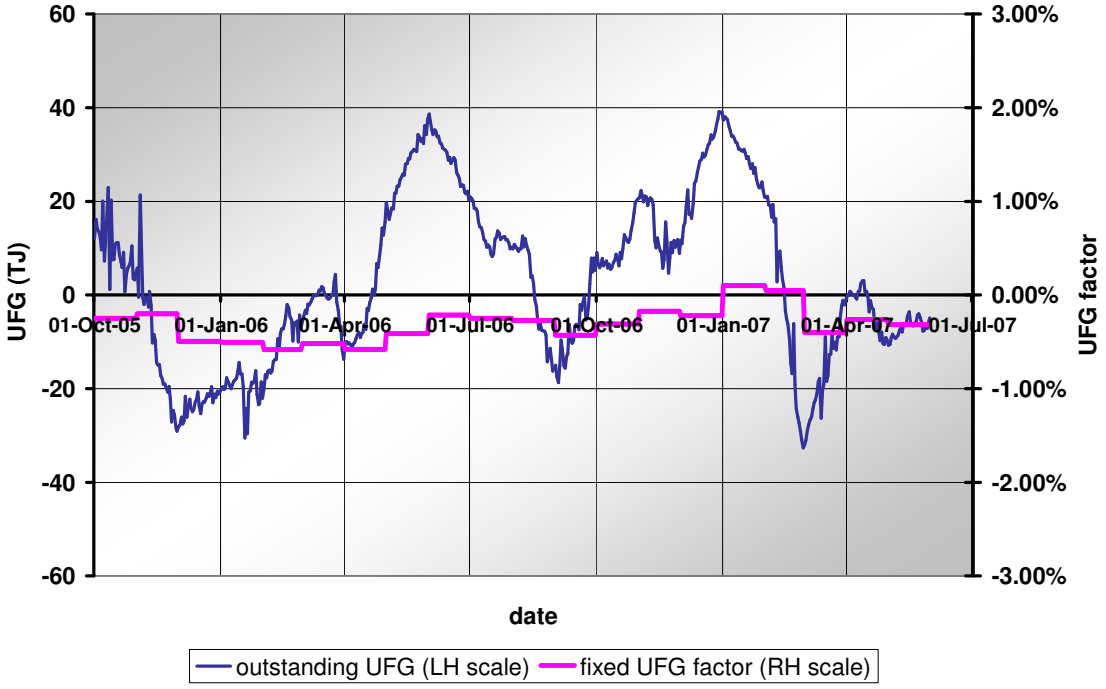
[19] that is, total UFG for the month divided by total receipts plus total deliveries for the month

[20] the proportion used here is 50%. Using a higher proportion will reduce the overall outstanding level of UFG but also create more volatility in the monthly UFG factors, as there is a greater tendency for them to "overcorrect".

[21] by comparison, minimum daily OI limits specified in the MPOC sum to 30TJ

[22] Similar levels of outstanding UFG would be expected under the PO Trading option, as the PO similarly has to project how much UFG is likely to occur in the future as well as trading out any outstanding UFG which has accumulated in the past.

Figure 4: Outstanding UFG after using monthly Fixed UFG Factor



Retrospective meter adjustment would cause a step change in the outstanding UFG amount and this would be reflected in changes to the fixed UFG factors in future months which would allow the additional UFG to be gradually cleared.

MDL UFG Allocated to VT

VT is the MDL WP at ICPs, so this option will allocate a significant proportion of UFG to VT, which it now needs to manage. So, in this respect, the problem of this UFG has not been resolved, but simply passed from one pipeline operator to another.

VT UFG

VT does not use OBAs at welded points on the VT pipeline, so the meter reading adjustment will not allocate the UFG to OI. The effect of the adjustment will vary by welded point:

- at ICPs, shipper allocated quantities are fixed, based on scheduled quantities on the MDL pipeline, so the UFG would simply be allocated back to VT;
- at gate stations with distribution networks, the UFG would be attributed to the distribution network's UFG[23] and allocated to shippers/retailers in accordance with the relevant reconciliation arrangements; and

[23] the distribution UFG is the difference between the metered quantity at the gate station and the aggregate of all downstream metered quantities. Therefore, an adjustment to the gate station metered quantity causes an equivalent adjustment to distribution UFG

- at other receipt points, the metered quantity is allocated in its entirety to shippers, so the UFG would be allocated to shippers, causing incremental changes to their mismatches.

So, the effect is to allocate it either to shipper mismatch (which is equivalent to option 3, below) or to pass it on to another pipeline operator to deal with.

Summary

There are a number of concerns with this option. In particular that:

- linepack measurement error may exacerbate uncertainty in OIs;
- retrospective meter correction may create a corresponding need to retrospectively correct OIs;
- a substantial proportion of the MDL UFG is not fully managed but simply passed on to VT to manage; and
- on the VT network, the UFG is either allocated to shipper mismatch, to VT or to a distribution network.

The former two issues could be addressed by using fixed UFG factors that are set in advance of the gas day. The latter two issues are problematic and are inherent weaknesses in this option.

The "logic" associated with allocating a WP "problem" back to the WPs, whilst intuitively appealing, is not in itself a compelling reason to adopt the option.

3.5. Option 3: Mismatch Adjustment

Description

Under this option, UFG would be allocated to shippers, through adjustment to shipper mismatch. This would be done in proportion to shipper deliveries, using a UFG factor similar to the Meter Reading Adjustment option. The UFG factor would be calculated using the formula:

$$K = UFG \Big/ \sum_j abs(NQ_j)$$

Shipper mismatch would be adjusted using the formula:

$$DMM_j = MM_j - K * NQ_j$$

where:

MMj is the mismatch for shipper j
DMMj is the "deemed" (ie adjusted) mismatch for shipper j

NQj is the total nominated receipts[24] for shipper j

Appendix 3 shows how using deemed mismatch allows UFG to be eliminated from the imbalance equation, which becomes:

$$ALP = OI + DMM + COG$$

So, similarly to the previous option, UFG has been eliminated from the balancing equation. This is done by allocating it to shipper mismatches.

Issues arising under this option are discussed below.

Impact on Mismatch Management

On the MDL pipeline, shipper mismatches arise only rarely: for example as a result of curtailment of nominations. In the light of this, the MPOC arrangements have been designed so that, whenever mismatches do arise, MDL will issue mismatch notices requiring shippers to bring their mismatch back to zero within a specified period.

Under this option, mismatches will accrue daily (or however often the UFG is allocated), and so it will be impractical to reduce mismatches to zero. MPOC arrangement will need to change to reflect this. This could be done by specifying mismatch limits and requiring the PO to take action only when running mismatch amounts exceeded these limits, in a similar manner to the arrangements for OI.

On VT pipelines, on the other hand, mismatches accrue routinely and shippers are expected to manage these. VT does not place any specific limits on mismatch amounts. Instead, VT allocates its balancing costs to shippers in proportion to their overall mismatch amounts.

Therefore, the impact on shippers of this option is analogous to the impact of the Meter Reading Adjustment option on MDL WPs. It will add to the level of shipper mismatches and will create some additional costs and uncertainties as a result. To minimise uncertainty, the allocation would ideally occur daily in arrears.

Linepack Calculation Error

If UFG is allocated daily, linepack calculation error may create additional uncertainties and costs, in an analogous way to that for the Meter Reading Adjustment option.

Impact on Downstream Pipelines

Because this option does not directly affect scheduled quantities or OI amounts, there are also no direct effects on downstream pipelines. In particular, if this option were applied to manage MDL UFG, there would be no direct effect on VT or VT shippers. Whilst MDL shippers affected by the adjustments may seek to pass on costs to their downstream customers, this would be a matter for them individually and would not need to be addressed in the pipeline arrangements.

[24] Note that it could be based either on shipper receipts or shipper deliveries and these should be approximately equal. For reasons discussed below, it is more practical to use receipts.

Similarly, applying this option on the VT pipelines would not directly affect downstream customers, distribution UFG or reconciliation arrangements.

Because the adjustments are based on receipt quantities, they should not be affected by the downstream reconciliation arrangements, except to the extent that these indirectly affect receipt quantities.

Retrospective Meter Adjustment

The impact of this on shipper mismatches would be analogous to the impact on WP OIs under the Meter Reading Adjustment option.

Using a Fixed UFG Factor

As for the Meter Reading Adjustment option, using a fixed UFG factor that was set in advance would address the problems of uncertainty. It would also allow shippers to maintain their mismatch at zero. For example, at present a shipper wishing to deliver 100TJ of gas must nominate deliveries totalling 100TJ and also receipts totalling 100TJ. If the fixed UFG factor were +1% (say), deliveries would still need to be 100TJ but receipt nominations would now need to aggregate to 101TJ, so that the deemed mismatch amount was zero.

Summary

This option raises similar issues to those in the Meter Reading Adjustment option, except that, whereas that option creates risks for WPs through OI uncertainty, this option instead creates risks for shippers through mismatch uncertainty.

On the other hand, because it does not depend upon the existence of OBAs, the impact is the same on both the VT and MDL pipelines. Furthermore, the problem of the MDL UFG being passed on to the VT pipeline does not arise. The UFG is dealt with entirely within each pipeline.

A significant weakness is that the mismatch management arrangements under MPOC are only designed to address occasional mismatches and would need to be adapted if mismatch were to become more routine. This could be addressed through the use of fixed UFG factors.

3.6. Combined Pipeline Operations

Description

Under this variation to each of the previous three options, UFG would be managed as a single quantity across all MDL and VT pipelines, rather than separately for each pipeline. As before, UFG would be defined as the difference between actual linepack change and expected linepack change, but the linepack referred to would now encompass MDL and VT pipelines. This UFG will be referred to as “system UFG”

Meter inaccuracies at ICPs have equal and opposite effects on MDL UFG and VT UFG and so have no effect on system UFG.

Arrangements for managing system UFG could be based on any of the previous three options, as discussed below.

Option 1A: Combined PO Trading

Under this option, one of the POs[25] would take responsibility for buying or selling the system UFG, using the same approach as was described for pipeline UFG. The costs or revenues associated with this activity would be shared between the two pipelines on some agreed split: eg in proportion to the aggregate receipt and delivery quantities on all welded points on a pipeline, excluding the ICPs. The PO's would pass on these costs/revenues to shippers in the same way as for pipeline UFG.

Option 2A: Combined Meter Reading Adjustment

Under this option, metered quantities at all welded points on all pipelines, excluding the MDL-VT interconnection points, would be adjusted by a common scaling factor, with quantities at receipt and delivery points scaled in opposite directions as for the pipeline UFG option. The scaling factor would be specified so as to allocate all system UFG and so to eliminate it from the imbalance equation.

The impacts would be as described under the Meter Reading Adjustment option. Thus, in relation to MDL welded points, it would cause incremental changes to OI amounts which would need to be managed by MDL welded parties. In relation to VT welded points, it would either cause incremental changes to mismatch amounts, which would need to be managed by VT shippers or would be passed through to distribution UFG.

Option 3A: Combined Mismatch Adjustment

Applying this option to system UFG would mean allocating it to shipper mismatches in proportion to each shipper total receipt nominations (or receipt amounts in relation to VT shippers). However, a question arises as to whether receipts from ICPs should be excluded:

- if they are excluded, VT shippers receiving gas solely from ICPs would receive no UFG allocation; but
- if they are not excluded, a shipper transporting gas through both the MDL and VT pipelines would be allocated UFG twice: once in relation to receipts into to the MDL pipeline and once in relation to deliveries to ICPs, thus bearing twice the burden and risk of other shippers.

On reflection, it appears more consistent and appropriate to exclude receipts at ICPs. Although a VT shipper receiving gas from ICPs would then avoid the UFG impact, its "sister" MDL shipper, delivering the gas to those ICPs, would pick up its share.

Issues arising under these options are discussed below.

Inter-pipeline Balancing

It is not proposed in this option to also introduce "systemic" balancing arrangements. Although this concept has its attractions, it is outside the scope of this report. Therefore, there is still the prospect of operational imbalances occurring between MDL and VT pipelines and the systemic treatment of UFG could exacerbate this.

[25] It would be feasible for the responsibility to be split – eg 50:50 – but this would just add to transaction costs.

For example, suppose that all of the systemic UFG accrued on a VT pipeline (after taking into account the meter readings at the interconnection points), but that the UFG was "managed" entirely on the MDL pipelines: eg because, under the "PO trading" option, MDL takes responsibility for UFG and buys or sells all of the UFG from its pipeline.

Just as "unmanaged" UFG inevitably leads to an equal and opposite OI (assuming mismatches are managed to zero), "managed" UFG which doesn't actually exist – because it exists on the other pipeline – will lead to a corresponding OI. So, under the above scenario, OI would accrue at ICPs. To address this, there would need to be a notional "cashout" of OI (at a zero price), corresponding to the amount of UFG imbalance.

The amount of this cashout would need to be properly calculated, to ensure that it did not provide one of the pipelines a "free" balancing service at the expense of the other. These calculations are not undertaken in this report – since they will depend upon which option is developed – but they should be relatively straightforward.

Value Transfer between Pipeline Users

If UFG solely arises on one pipeline, say, but the impact is shared between users of both pipelines, there may appear to be a value transfer from the owner or users of one pipeline to the other.

However, like other such value transfers (eg between shippers and WPs), this value transfer does not create moral hazard because incentives to maintain meter accuracy remain unchanged. Furthermore, since it is uncertain whether meters on the ICPs will run fast or slow, it is correspondingly unclear which direction any value transfer would be in and whether such direction would be maintained over a sustained period.

Cancellation of UFG offsets

To the extent that UFG on an individual pipeline arises as a result of metering inaccuracies at an ICP (and so creates an equal and opposite UFG on the interconnected pipeline), this UFG will not appear at the system level. Therefore, the prospect of the two POs trading opposite UFG amounts (ie one buying and one selling) and opening themselves to loss of value through arbitrage does not arise.

Establishment Costs

Under each of these options, new relationships between the two pipeline operators would need to be established. In Combined PO Trading, one PO takes responsibility for trading the system UFG and its new rights and obligations (including, for example, liabilities or indemnities) would need to be agreed with the other PO. The mechanism for sharing the UFG costs or revenues would also need to be established.

In all the options, the OI cashout arrangements need to be defined, so that VT remains responsible for the OI that accrues as a result of VT shipper mismatches.

Summary

Combining pipeline operations creates clear benefits in two areas:

- it reduces transaction costs under the PO Trading option, since all UFG is managed by one PO; and
- it means that any UFG created by meter inaccuracies at ICPs does not need to be managed, except to the extent that some notional cashing out of the corresponding inter-pipeline OI would be necessary.

On the other hand, there may seem to be some inconsistency in having a combined pipeline approach to UFG but separate treatment of other imbalances. There may also be some establishment costs associated with setting up the combined operations.

3.7. Conclusions and Recommendations

The Meter Reading Adjustment option, though intuitively appealing as it assigns meter errors back to meters, appears to create more complexity than the other options in two ways. Firstly, it passes UFG between pipelines, meaning that it has to be dealt with twice[26]. Secondly, it has different impacts on the two pipelines: on the MDL pipeline it creates operational imbalance and so impacts WPs, whereas on the VT pipeline it creates mismatch and so affects shippers. This complexity also arises to some extent with combined pipeline operations. Therefore, this option is not recommended.

The Mismatch Adjustment option applied on a daily basis would inevitably create mismatches on the MDL pipelines, which the current MPOC arrangements are ill-equipped to manage. However, by using a fixed UFG factor, set in advance, MDL shippers could continue to avoid mismatch. Therefore, this option appears feasible.

However, the inclusion of the fixed UFG factor would likely require changes to OATIS which may be expensive. There may also be some expense associated with calculating outstanding UFG immediately after month end, so that the following month's fixed UFG factor can be calculated. Finally, some outstanding UFG will accrue when a fixed UFG factor is used – although this will oscillate around zero – which may create some additional balancing costs which are likely to be passed through to shippers.

The PO Trading option suffers from the perception of a potential loss of value and the lack of incentives on the POs to maximise UFG value. However, these perceptions may be influenced by the large amounts of current outstanding UFG. If UFG were cleared monthly, the amounts would remain moderate and value concerns may be diminished. VT employs this option currently and there do not appear to be substantial value concerns in this respect. The PO Trading option is less likely to require changes to OATIS, which already has functionality to manage the purchase and sale of balancing gas.

[26] and may have to be dealt with a third time if it is passed on again to distribution networks

Since the PO is likely to be trading only periodically (eg monthly), there will be some outstanding UFG, although this should oscillate around zero. It is likely to be similar in character and magnitude to the outstanding UFG when using a fixed UFG factor for Mismatch Adjustment.

There appear to be significant benefits from combined pipeline operations, which could be applied to either option. Having combined UFG operations may appear inconsistent with having separate balancing operations, but this inconsistency should be easily manageable. Indeed, combined UFG operations might be seen as a useful first step towards combined balancing.

In summary, two options seem to be worthy of further consideration:

- option 3A (Combined Mismatch Adjustment) using a fixed UFG factor; and
- option 1A (Combined PO Trading), if the OATIS changes associated with implementing option 3A are too costly.

In these two options, we have a choice between a commercially attractive but potentially higher (transaction) cost option (Option 3A), and a lower cost but less attractive option (option 1A), where opportunity costs may arise in the loss of value involved in the PO trading.

Based on the analysis described above, Option 3A is preferred. However, this is based on an expectation that the additional transaction costs – in particular the changes required to OATIS – associated with this option are moderate in comparison to typical values of UFG. If, on further investigation, these costs appear likely to be substantial (eg greater than 10% of UFG value on an annualised basis), option 1A should be considered instead.

In this event, there will need to be some further consideration of the establishment costs associated with setting up combined PO trading. Again, if these are substantial (eg greater than 10% of the value of the UFG that is "double-counted" at ICPs), then option 1 (ie separate PO trading) should be adopted, rather than option 1A. In that case, combined UFG management would only be introduced if and when a combined balancing arrangement is implemented.

4. Reconciling Historical UFG

4.1. Overview

Objective

The objective of the reconciliation would be to manage to zero the outstanding UFG that has accrued since commencement of MDL open access. As this is done, POs may need to undertake balancing actions to bring the corresponding OIs or MMs towards zero. This latter requirement is not directly addressed in this report, although constraints that it may place on the UFG solution are taken into account.

VT Position

It is understood that VT has largely traded out its UFG position, so significant outstanding UFG only exists on the MDL pipeline. This means that the issue of reconciling the historical position entirely relates to the MDL pipeline.

Legal Considerations

The MPOC is silent on how UFG should be managed and how the costs or revenues associated with UFG should be allocated between the PO, shippers and WPs. Therefore, the legal entitlements of these parties are currently unclear. However, given the value of the accrued UFG – likely to be in the millions of dollars – it would not be unexpected if some parties sought to have their legal position clarified, potentially through the courts.

CEC's expertise is in the commercial arrangements for the use of open access pipelines and in the economic and practical implications of alternative approaches. We are not qualified to provide – and this report does not provide – any legal opinion about the express or implied rights of parties to a share of the UFG value or about the merits of alternative approaches. We are approaching this issue solely from an economic and practical perspective. It may be the case that legal issues are addressed through some form of legal settlement which accompanies the reconciliation process.

Consistency with ongoing solution

Whilst consistency between the solutions to historical and future UFG management may have some intuitive appeal, there are significant differences between the two problems which may therefore warrant different solutions. In particular:

- there is a very large amount of outstanding historical UFG, whereas the amounts of future outstanding UFG are likely to be small, so long as they are managed in a timely fashion;
- the reconciliation solution applies only to the MDL pipeline, whereas solutions for the future may apply to both pipelines: thus, for example, the "combined pipeline operations" is an option for the future but is not a reconciliation option;
- the historical situation is that a large amount of OI – corresponding to the outstanding UFG - has accrued at a single welded point (Oaonui); these circumstances would be unlikely to be repeated going forward;

- historical UFG is known to be negative: therefore the direction and magnitude of any notional value transfers associated with one option or another are also known; the direction and magnitude of future value transfers depend upon the future direction and magnitude of UFG, which are uncertain; and
- conversely, whereas future options may create uncertainties for pipeline users, reconciliation options are unlikely to create any uncertainty since their effects on individual parties should be easily predicted[27].

In this respect, the main objectives for the reconciliation solution are:

- ensuring practicality and low transaction costs;
- minimising operational and commercial impacts as far as possible; and
- ensuring equity – or "perceived" equity – to reduce the likelihood of legal challenges from parties who consider that they have been unfairly treated.

Amount of UFG to be reconciled

The amount of UFG to be reconciled is the outstanding UFG: ie the total UFG minus the total gas purchased by the MDL CO as a result of cashed-out OI or balancing gas. The latter would include own-use gas not specifically contracted for.

Reduction of Oaonui OI

An issue common to all reconciliation options is that (assuming that other imbalances remain close to zero), as the historical UFG is progressively cleared, the Oaonui negative OI must increase, towards zero, at a corresponding rate, so that the pipeline remains in balance. To achieve this, production from the Maui field must exceed scheduled quantity by a corresponding amount. This would presumably be done by the MDL CO issuing balancing gas call requests to the Oaonui WP.

Given that Maui has finite production capacity and some existing contractual commitments, there will be some upper limits on the rate at which OI can be reduced. These limits need to be determined, since they will constrain the rate at which UFG can be resolved, under all of the options. This should be done by the MDL CO who is the counterparty to the Oaonui balancing arrangements.

Generational Value Transfer

Given that the UFG has accrued over the 20 months or so since early open access in October 2005, a question arises as to whether these proceeds ought to be allocated to parties (specifically shippers[28]) who were active over that period, or to parties who are active in the (future) period over which the outstanding UFG is to be reconciled.

In our view, and irrespective of the legal position, any solution which fails to allocate the UFG value to parties active over the historical period may be seen as inequitable and so

[27] Except that there may be some uncertainty over the value to be realized under the PO trading option

[28] Welded Parties and pipeline owners will generally be the same over the historical and future periods

will be less likely to command general support. Therefore, generational equity is an important principle that should be adhered to – where reasonably practical – in developing a solution for reconciling historical UFG.

Timing of Reconciliation and Future Arrangements

It would be preferable that:

- a historical reconciliation occurs only once; and
- an ongoing process for managing UFG commences immediately following the reconciliation period.

To achieve this, the chronology of the reconciliation and future processes should be as follows:

- the reconciliation and future UFG processes are each agreed upon;
- a "transition date", D, is specified on which the future UFG process commences;
- the total outstanding UFG over the "historical period " from 1st October 2005 to D-1 is calculated; and
- the reconciliation and future UFG processes may operate in parallel for some period after date D, until the reconciliation process is complete.

4.2. Options Considered

Five reconciliation options are considered in this report:

- Option H1: PO Trading
- Option H2: Meter Reading Adjustment
- Option H3: Mismatch Adjustment
- Option H4: Settlement in Cash (at Oaonui)
- Option H5: Settlement in Kind (at Oaonui)

The first three options are analogous to the corresponding options for future UFG management. The fourth and fifth options would see the UFG allocated to the Oaonui WP in its entirety, largely extinguishing both the UFG and the OI at Oaonui at a single stroke. All of these options are discussed below.

4.3. Option H1: PO Trading Option

Description

This option is similar to the corresponding option for future UFG management. The key difference is that there is a much larger amount of UFG to sell than would normally be the case in the future.

Issues arising under this option are discussed below.

Market Impact

The sale of a substantial amount of gas could depress the market price and lead to a loss of value. However, there is no particular urgency in the UFG sale: it certainly need not be a "fire sale". The PO could sell the UFG over an extended period, perhaps up to several years. It could do this either through a single tender process or a series of tenders.

Loss of Value

As for the future UFG solution, there may be a concern that the MDL fail to maximise the proceeds of the UFG sale. To address this concern, it may be possible to arrange for the sale to be undertaken by an "energy broker" who could be incentivised to maximise value: eg by being paid a percentage commission. The ultimate recipients of the sale proceeds should be consulted on the choice of broker – who should be independent of them and of potential bidders for the UFG – although the final decision should be the PO's.

Generational Equity

To ensure generational equity, the proceeds could be allocated to shippers – or other parties – in proportion to their gas flows over the historical period. This may be problematic, however, where the shipper has since gone out of business.

Contingency Fund

It has been suggested that some or all of the UFG proceeds could be placed in a contingency fund to help to fund future costs of pipeline operations: for example balancing costs or associated payments.

This again raises issues of generational value transfer, since the beneficiaries of this trust would then be future shippers rather than current or historical shippers. An issue of greater concern, however, is that subsidising future costs may create moral hazard and so worsen rather than alleviate balancing problems. Therefore, this suggestion is not supported.

Synergies with OUG and BG

The separate treatment of UFG may cause potential synergies with OUG and BG to be lost. However, this could be addressed, in part at least, by the MDL CO itself bidding for the gas (particularly if it was being sold by an independent broker) for balancing or OUG needs.

Transaction Costs

Given the relatively large amount of gas for sale at one time, transaction costs are likely to be relatively small as a percentage of gas value.

Ring-fencing Concerns

These would be addressed if the sale were carried out by an independent broker.

Value Transfer from WPs to shippers

WPs who felt that they had a reasonable claim to some of the UFG or its proceeds may be aggrieved that all of the proceeds are passed to shippers. Indeed it is possible that other stakeholders – for example pipeline owners – may feel that they have some legal or moral right to a share of the UFG.

These concerns could be addressed by sharing the proceeds between these various claimants on some agreed basis. Some form of negotiation and settlement may be needed to arrive at this agreement. Since such an agreement is likely to reflect the respective legal rights and claims of the various stakeholders, it is outside the scope of this report.

Oaonui OI

The amount of UFG that is sold on any day must be less than the daily limits on Oaonui OI adjustment, discussed in section 4.1, otherwise the MDL CO may be unable to balance the pipeline. These limits would need to be agreed between the MDL CO and the Oaonui WP and then provided to the broker, who would ensure that gas was not sold that could not be physically produced on the day.[29] The limits could remain confidential to the MDL CO and the broker.

Summary

This option would appear to be most satisfactory if the UFG were sold by an independent, incentivised broker and if the proceeds were allocated equitably between welded parties, shippers and any other relevant stakeholders active over the historical period. However, if a suitable broker – with a reasonable fee - cannot be found and agreed upon, the trading would need to be undertaken by the MDL CO.

[29] This raises the interesting possibility that the Oaonui OI limit could be increased if the UFG purchased by a shipper was used to offset its reliance on Maui gas. In practice, it would be difficult to verify whether that was indeed the case. Even if this were possible, it would mean that the broker may discriminate between shippers: able to sell gas to shipper A (displacing Oaonui nomination) but not from shipper B, even though shipper B (potentially) bid a higher price.

4.4. Option H2: Meter Reading Adjustment

Description

This would be similar to the corresponding option for future UFG management. However, given that it is retrospective, there is no need to adjust daily metered quantities for every day in the historical period. Instead, there would be a one-off adjustment to the running OI at each welded point. The adjusted ("deemed") OI would be calculated using the formula:

$$DOI_i = OI_i - K * HMQ_i$$

where

OI_i is the running operational imbalance immediately prior to the adjustment

DOI_i is the deemed running operational imbalance immediately after the adjustment

HMQ_i is the historical aggregate metered quantity (in absolute value) for that welded point over the historical period

K is the UFG factor, determined using the equation:

$$K = \frac{HUFG}{\sum_i HMQ_i}$$

HUFG is the total outstanding UFG over the historical period

Given that UFG is negative, this will lead to an upward adjustment of OI following the reconciliation, meaning that:

- the high negative OI at Oaonui will be reduced in magnitude although DOI will still be highly negative;
- all other welded points are likely to have a high positive DOI; and
- DOI aggregated across all points should be close to zero.

The last point follows from the Imbalance Equation:

$$ALP = DOI + MM + COG$$

derived in Appendix 2.

Issues arising under this option are discussed below.

OI Impact

If the OI adjustment were done in one "hit", all or most welded points would have an OI well outside of their operational limits, exposing them to the risk of cashout. Whilst the PO could offer an "amnesty" period, this would then largely remove incentives for WPs to manage their daily OI position[30]. Given the size of the OI adjustment, the amnesty may be needed for an extended period.

There are two options to address this issue:

- instead of a single adjustment to OI, have a series of incremental adjustments: for example, 1/365 of the OI adjustment could be scheduled for every day for a year;
- instead of setting OI tolerance limits around zero, set these limits around a "trajectory" of decreasing, positive OI over an extended period as shown in figure 5, below.

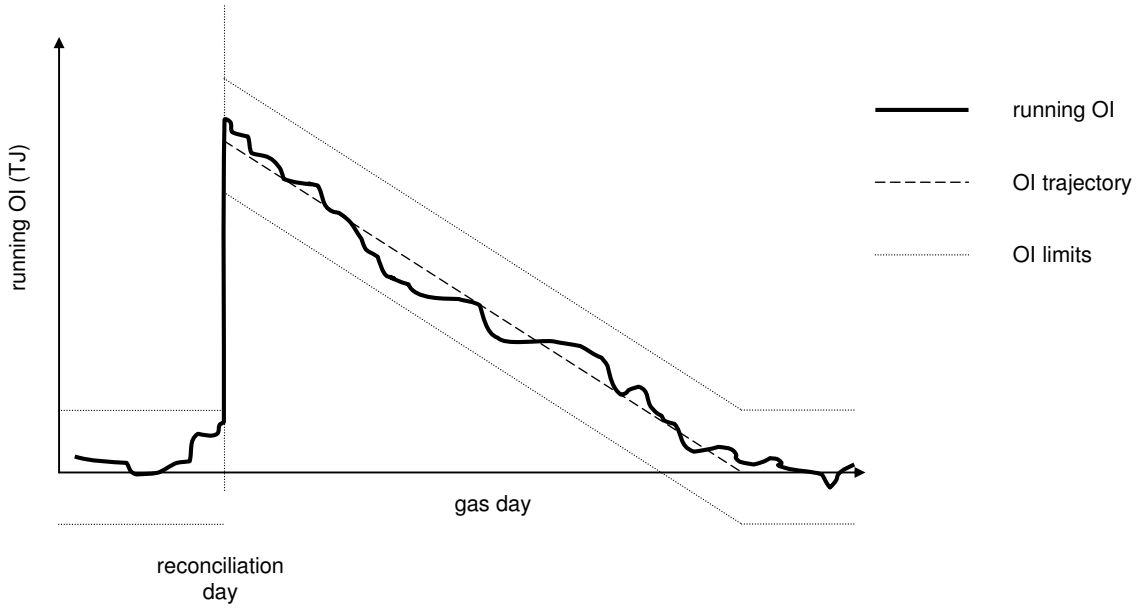


Figure 5: OI Trajectory

In fact, these options really amount to the same thing. The first approach may be easiest to implement, as it would not necessitate any changes to the existing OI arrangements.

The OI trajectory would also need to take into account the daily limits on Oaonui WP's balancing capability discussed previously.

[30] they would still need to keep negative *daily* OI within limits to avoid the risk of incurring costs through the incentives pool arrangement

Impact on VT

The OI adjustment would apply at ICPs and so create positive OI at these points which VT would need to manage. Indeed, OI at these points would amount to a significant proportion of the overall OI adjustment.

VT could handle this UFG-related OI in the same way as it manages its indigenous UFG. If VT decided to adopt a new regime for this going forward, it could use this regime to manage the OI adjustment or it could, alternatively, trade it out as it does currently. A further option would be to undertake its own one-off reconciliation to manage the UFG allocated from MDL.

Whatever the approach, we have an issue (similar to that arising under the future arrangements) that the MDL UFG has not been reconciled in its entirety, since a portion of it has been allocated to VT, who then needs to manage it a second time.

Summary

This option creates significant complexity associated with how OI should be managed over the period of reconciliation. It also passes a substantial proportion of the UFG to VT, which must then be reconciled a second time.

4.5. Option H3: Mismatch Adjustment

Description

In this option, the historical UFG would be allocated to shipper mismatch in proportion to historical total receipts: ie using the formula:

$$DMM_j = MM_j - K * HNQ_j$$

where

MM_j is the mismatch for shipper j
DMM_j is the "deemed" (ie adjusted) mismatch for shipper j
HNQ_j is the total nominated receipts for shipper j over the historical period

and the UFG factor, K is determined by the formula:

$$K = \frac{HUFG}{\sum_j HNQ_j}$$

Issues arising under this option are discussed below.

Impact on MM

As with the future UFG management option, Mismatch Adjustment may cause MDL shippers to incur chronic mismatch, which the MPOC is ill-equipped to deal with. However, this may be avoided by breaking down the mismatch adjustment into smaller daily quantities.

For example, consider a shipper whose total mismatch adjustment is 365TJ, based on the UFG factor and its historical flows. If this adjustment were spread over 1 year, the daily adjustment would be 1TJ. Thus, mismatch could easily be avoided by the shipper making daily receipt nominations which are 1TJ greater than its daily delivery nominations.

Breaking the adjustment down in this way could also ensure that the adjustment on a day did not exceed the capacity of Oaonui WP to deliver a corresponding amount of balancing gas.

Historical Shippers

Since the UFG is allocated based on historical nominations, it is possible that some of the shippers who receive an allocation are either no longer shipping gas or are shipping much smaller quantities than in the historical period. Such shippers are unlikely to be able to manage their mismatch back to zero.

It may be possible to arrange mechanisms for these shippers to sell their mismatches to currently active shippers, but this would introduce further complexity.

Summary

This option is feasible, except for the problem of allocating mismatch to shippers who are no longer active.

4.6. Option H4: Settlement in Cash (at Oaonui)

Description

Given that the outstanding UFG and the running OI are approximately equal and opposite, an option which involves selling the UFG in its entirety to the Oaonui WP has the potential to erase both outstanding amounts at a single stroke. Notionally, the Oaonui WP acquires the 1.25PJ of UFG and then uses this gas to pay off its OI "debt". This would be entirely an accounting transaction: no actual gas would need to flow at Oaonui to effect the transaction. In this option H4, the Oaonui pays for the gas in cash; in the next option H5 it is paid for in kind through a pre-paid gas sales agreement (GSA).

For this option, the reconciliation process would be as follows:

- the MDL CO and the WP at Oaonui would agree a settlement price;
- MDL CO would cash out OI at Oaonui – to an amount equivalent to the outstanding historical UFG or the level of Oaonui OI, whichever is the lower;
- the Oaonui WP would make the agreed payment to the MDL CO; and
- the MDL CO would pass this payment through to shippers or other stakeholders in the manner discussed in the PO Trading option.

Issues arising under this option are discussed below.

Loss of Value

There is the same loss of value issue as in the PO Trading option, of which this can be seen to be a specific example. The concern here is exacerbated by the fact that there is only one potential buyer of the UFG and so there is no possible competitive process to set a market price.

Ring-Fencing

The loss of value concern is exacerbated by the fact that MDL is affiliated with the Oaonui WP and so may be perceived to be amenable to agreeing a price which favours that party.

Maui Gas Contracts

Any settlement would either need to be consistent with existing contractual rights and obligations of the parties trading Maui gas or would be subject to the agreement of these parties.

Summary

The problem with this option is that it is not clear how a price for the UFG could be arrived at which would be satisfactory to everyone involved. Given the affiliation between MDL and the Oaonui WP, there would also be substantial conflicts of interests arising.

4.7. Option H5: Settlement in Kind (at Oaonui)

Description

The Settlement in Cash option has the attraction that it deals with the UFG and Oaonui OI in a single transaction, but has the critical flaw that there is no way to determine an appropriate settlement price.

This option H4 seeks to retain the strength of option H3 but avoid its flaw by arranging for the settlement to be in kind – ie for an equivalent quantity of pre-paid gas – rather than in cash. The settlement and reconciliation process is as follows:

- as for option H3, the MDL CO would agree with the Oaonui WP to settle OI at Oaonui – to an amount equivalent to the outstanding historical UFG or the level of Oaonui OI, whichever is the lower;
- however the *quid pro quo* for this, instead of cash as in option H3, is a gas sales agreement (GSA) – with the MDL CO as the buyer - for pre-paid gas, for the same overall amount as the settled OI; and
- the GSA will specify the maximum daily quantities (MDQs) and other contract variables (excluding price) normally seen in a GSA.

This transaction can be best understood by examining each party's assets or liabilities before and after the agreement. Before the agreement, the Oaonui WP has a liability of around 1.25 PJ of negative OI and the MDL CO has an asset[31] of 1.25 PJ of UFG. After the agreement, the Oaonui WP has as a liability an obligation to provide1.25 PJ of pre-

[31] without prejudice to the ultimate legal ownership of this UFG

paid gas and the MDL CO has as an asset the right to receive this pre-paid gas. So the amount of gas held or owed by each party is unchanged, but the form in which it is held has been transformed.

This resolves the issues of the OI and the UFG, but has not yet resolved the issue of how to "monetise" the value of the UFG, nor how to allocate this value to stakeholders. In fact, the position now becomes similar to the position in option H1, where the MDL CO has agreed with the Oaonui WP the daily rate at which the OI can be called back. The difference is that this agreement is now embodied in a GSA rather than being a supplementary understanding to the balancing arrangements between these two parties.

Therefore, the MDL CO, or an independent broker, can now market this prepaid gas in a way which maximises its value. The proceeds would be allocated between stakeholders in the same way as for option H1.

Issues arising under this option are discussed below.

Negotiating the GSA

A question arises, similar to that under option H3, as to how negotiate the GSA when there is only one potential buyer and one potential seller. However, this problem exists in another guise in all of the options. The GSA negotiation is simply about agreeing the MDQs and other limits on the delivery of the 1.25 PJ of gas. These limits must also be agreed in all of the options, to ensure that the MDL CO can continue to balance the pipeline.

Cutting out the Middlemen

This option involves two "middlemen": the MDL CO and the independent broker. It is worth considering whether it may be possible to reduce transaction costs by removing one or both middlemen.

Removing the independent broker would mean the MDL CO marketing the pre-paid gas rather than an independent broker. This is feasible and – as in the PO trading option – would be adopted if a suitable broker could not be found.

On the other hand, removing the MDL CO would mean the independent broker negotiating the GSA with the Oaonui WP and then marketing the pre-paid gas. The behaviour of a profit-seeking broker in these negotiations may undermine the goodwill required to reach an equitable solution and may therefore prolong the process. It should be appreciated that, at least as we understand it, the Oaonui WP is receiving no remuneration for the balancing service that it provides to the MDL CO and so it should not be expected to incur any unnecessary costs in unwinding the OI accumulated in providing this service. For these reasons, there is value in retaining the MDL CO as a party able to negotiate with Oaonui WP in good faith and balance the competing interests of the Oaonui WP and the ultimate recipients of the UFG proceeds.

Finally, removing both "middlemen" would mean the Oaonui WP marketing the 1.25PJ of gas directly to shippers but, of course, receiving none of the proceeds. The Oaonui WP is unlikely to have the capacity or the willingness to undertake such activity for no commercial reward. There would also need to be new ring-fencing arrangements around the Oaonui WP to ensure they did not enter into "sweetheart" deals with affiliates. Therefore, this approach appears to be unsatisfactory.

Balancing Benefits

This option has the benefit of completely separating the UFG problem from pipeline balancing. The Oaonui OI returns to zero and there is no risk that the UFG may be disposed of at a faster rate than can be accommodated by balancing tools.

Summary

This option combines the simplicity and effectiveness of the PO Trading option with the immediate resolution of the outstanding OI. By formalising the obligation of the Oaonui WP to "repay" the Oaonui OI, and defining the conditions under which this will be done, it minimises the likelihood of balancing problems arising during the period over which the UFG is disposed of.

4.8. Conclusions and Recommendation

Identification of the Preferred Option

The large impacts created, in the Meter Reading Adjustment and Mismatch Adjustment options, on OI and MM, respectively, mean that the reconciliation would need to take place over an extended period and so would operate in parallel with future UFG adjustment. This potentially creates some additional complexities and inconsistencies.

The Mismatch Adjustment option may allocate mismatch to shippers who are no longer active and who are therefore unable to manage their mismatch position. This could be addressed by allocating mismatch to current shippers instead, but this would create generational inequity. The Meter Reading Adjustment option, on the other hand, would allocate a significant part of the UFG to VT, who would then itself need to reconcile or manage this UFG. On this basis, neither of these options is supported.

The Settlement in Cash option has been rejected, since there is no appropriate process for setting the price. The remaining two options – PO Trading and Settlement in Kind – have many features in common but also some important differences.

There are two common features. Firstly, they both involve monetizing the outstanding UFG using an independent, incentivised broker and then allocating the cash proceeds to the relevant stakeholders who were active over the historical period through some negotiated settlement. Secondly, they both require[32] that the daily capacity of the Oaonui WP to "repay" its OI must be determined, in order to place a limit on the daily quantity of UFG that is sold.

There are three important differences. Firstly the limits placed on the UFG trading are, in the PO Trading option, incorporated into the balancing arrangements, whereas in Settlement in Kind they are specified in a new GSA. Capacity provisions in GSAs are well established and understood and we can have confidence that a GSA established between the MDL CO and the Oaonui WP will be complete and well-defined in this respect. The balancing arrangements, on the other hand, are somewhat novel and it is less clear how they might be defined and enforced.

[32] As do the rejected options also

Secondly, the two options will have different operational impacts. Under PO Trading, any purchase of the historical UFG on a day will create an imbalance which the MDL CO will need to respond to by calling on the balancing arrangement at Oaonui. Although the amount of UFG sold should not exceed the balancing capability of Oaonui, there is still an operational risk that the MDL CO may not be aware of the imbalance and may not respond to it in time. Under Settlement in Kind, however, the "UFG purchase" would instead involve a nomination to the Oaonui WP to deliver some of the pre-paid gas in accordance with the GSA. Assuming that Oaonui WP produces in accordance with the scheduled quantity there are no balancing implications and the MDL CO needs take no action. Therefore, operational risks should be lower[33]

Finally, under the PO Trading option, the OI at Oaonui remains initially at its extreme negative position and only reduces over time as balancing calls are made in response to the sell down of the outstanding UFG. This creates some uncertainty about the obligations and liabilities of the Oaonui WP in relation to its OI: if not between the Oaonui WP and MDL CO (who presumably have some private understanding on this), at least in the industry at large. Under the Settlement in Kind option, the Oaonui OI is reduced to zero – or close to zero – at the time at which the pre-paid GSA is established and, in accordance with the MPOC, should remain close to zero thereafter. Such an outcome should give stakeholders greater confidence in the operation of the MPOC balancing arrangements.

On the basis of this analysis, Settlement in Kind is the recommended option.

Actions Required

To implement the Settlement in Kind option, the following steps need to be undertaken:

- the MDL CO and Oaonui WP must determine and agree constraints on the capacity of the Oaonui to "repay" the outstanding OI – or equivalently to produce in excess of its existing contractual commitments;
- the historical stakeholders must agree a mechanism for allocating the monetary proceeds from the UFG reconciliation and establish (probably through the MDL CO) a settlement system for distributing them;
- the MDL CO must specify a transition date on which the future UFG arrangements commence and then calculate the outstanding UFG and the Oaonui running OI on this date;
- the MDL CO and Oaonui WP must then negotiate a pre-paid GSA for a total gas amount equal to the lower of the outstanding UFG and the Oaonui OI, to be delivered in accordance with the capacity constraints determined above;
- the MDL CO will, at the commencement date of the new GSA, reduce the Oaonui OI and the outstanding UFG by the amount of gas to be delivered under the GSA. Any residual UFG is then rolled into the future UFG arrangements;

[33] In the event that the Oaonui WP is unable to produce in accordance with the nominations, this is likely to be recognised prior to the day through the nominations approval process and should also not create any imbalances: the shipper with the rejected nomination will simply source gas from elsewhere.

- the MDL CO will seek to appoint an independent broker to market the new pre-paid gas. In the event it is not possible to appoint a suitable broker at a reasonable cost, the MDL CO will be the marketer of the pre-paid gas; and
- the broker (or MDL CO) will then sell the pre-paid gas over a period so as to maximise the proceeds, net of transaction costs. The proceeds are allocated to stakeholders in accordance with the allocation agreement.

Although many of the actions are undertaken between the MDL CO and the Oaonui WP, other stakeholders should be consulted as far as possible and kept informed of the progress and outcomes of these actions.

5. Conclusions and Recommendations

On the basis of the analysis described in this report, CEC concludes that:

1. UFG should be defined as the difference between the expected and actual change in linepack over a specified period. This is equivalent to the aggregate effect of physical meter inaccuracies over the same period.
2. To the extent that UFG is not offset by balancing gas bought or sold by the pipeline operator, it will be manifested in equal and opposite imbalances in linepack, mismatch or operational imbalance or a combination of these.
3. Based on information provided by the MDL CO, aggregate UFG over the period from MDL open access (1st October 2005) to the end of May 2007 is approximately minus 1.25PJ. Only a small amount of this UFG has been sold by the MDL CO. The remainder is primarily manifested as a large negative OI at Oaonui, as a consequence of the MDL CO issuing balancing put requests to the Oaonui WP in order to manage linepack.
4. It is understood that the majority of UFG accruing on VT pipelines has been bought or sold through a sequence of competitive tenders, such that there is only a limited amount of outstanding UFG on VT pipelines. Therefore, the problem of reconciling outstanding UFG is confined to the MDL pipeline.
5. Options for reconciling historical UFG and for managing future UFG have been developed based on the requirements of this report's terms of reference, discussions with stakeholders and some assessment of overseas practice. Six options for managing future UFG and five options for reconciling historical UFG have been described, analysed and evaluated.
6. The preferred option for future UFG management is "Combined Mismatch Adjustment". This involves allocating system UFG (MDL UFG plus VT UFG) to shipper mismatch based on the product of a UFG factor and each shipper's total receipt quantities at points other than the MDL-VT interconnection points. The UFG factor will be fixed in advance and adjusted monthly so that unallocated UFG is maintained at a low level. MDL Shippers will be required to nominate such that their daily mismatch – including the UFG allocation – is zero.
7. In the event that this preferred option turns out to be impractical or uneconomic to implement, an alternative option of "Combined PO Trading" should be considered under which one of the PO's takes responsibility for regularly buying or selling outstanding system UFG, with the costs or proceeds split between the two pipelines and then used to offset shipper tariffs in accordance with the respective policies of the two pipeline owners. A third alternative of separate PO trading (ie each PO trading its own pipeline UFG) should also be considered to see if this is more economic than the combined approach.

8. The preferred option for historical UFG reconciliation is “Settlement in Kind at Oaonui”. This involves the outstanding historical MDL UFG being given to the Oaonui WP in exchange for the Oaonui WP agreeing to sell an equivalent quantity of pre-paid gas to the MDL CO under terms specified in a Gas Sales Agreement. The transferred UFG would be used by the Oaonui WP to extinguish (or largely extinguish) the large negative OI at Oaonui. The prepaid gas would be marketed to shippers through an independent broker appointed by the MDL CO. The proceeds would be shared between stakeholders who were active during the period over which the historical UFG has accumulated, in accordance with a settlement to be negotiated and agreed between these parties.
9. Once the necessary actions have been completed to agree and implement these preferred solutions, a transition date will be specified by the MDL CO. All MDL UFG accruing prior to this date should be reconciled in accordance with the preferred historical reconciliation solution. All UFG accruing after this date should be managed in accordance with the preferred future UFG solution.

Appendix 1: Derivation of Imbalance Equation

We have the following equations:

$$UFG = MQ - AQ \quad (1)$$

$$AQ = ALP \quad (2)$$

$$OI = MQ - SQ \quad (3)$$

$$SQ = MM \quad (4)$$

Rearranging equation (3) we have:

$$MQ = OI + SQ$$

Substituting for SQ using equation (4) we have:

$$MQ = OI + MM \quad (5)$$

Substituting for AQ in equation (1) using equation (2) we have

$$UFG = MQ - ALP$$

Now, substituting for MQ using equation (5) gives us:

$$UFG = OI + MM - ALP$$

Appendix 2: Meter Reading Adjustment Eliminates UFG

Recall that the adjustment factor, K, is defined as

$$K = UFG \Big/ \sum_i abs(MQ_i)$$

From our definitions of DQ we have:

$$\begin{aligned} DQ &= \sum_i DQ_i \\ &= \sum_{i \in RP} MQ_i * (1-K) + \sum_{i \in DP} MQ_i * (1+K) \\ &= \sum_i MQ_i - K * \sum_i abs(MQ_i) \\ &= MQ - UFG \end{aligned}$$

where:

RP is the set of receipt point
DP is the set of delivery points

Now:

$$DOI_i \equiv DQ_i - SQ_i$$

So:

$$\begin{aligned} DOI &= DQ - SQ \\ &= MQ - UFG - SQ \\ &= OI - UFG \end{aligned}$$

Returning to the imbalance equation, we now have:

$$\begin{aligned} ALP &= OI + MM - UFG + COG \\ &= DOI + MM + COG \end{aligned}$$

Therefore, UFG is eliminated from the Imbalance Equation

Appendix 3: Mismatch Adjustment eliminates UFG

We have defined deemed mismatch (DMM) to be:

$$DMM_j = MM_j - K * NQ_j$$

where:

$$K = UFG \Big/ \sum_j abs(NQ_j)$$

MMj is the mismatch for shipper j
DMMj is the "deemed" (ie adjusted) mismatch for shipper j
NQj is the total nominated receipts for shipper j

Therefore:

$$\begin{aligned} DMM &= \sum_j DMM_j \\ &= \sum_j \left(MM_j - K * NQ_j\right) \\ &= \sum_j MM_j - K * \sum_j NQ_j \\ &= MM - UFG \end{aligned}$$

The Imbalance Equation becomes:

$$\begin{aligned} ALP &= OI + MM - UFG + COG \\ &= OI + DMM + COG \end{aligned}$$

Therefore, UFG is eliminated from the Imbalance Equation.