DISCUSSION DOCUMENT

Modification Proposals to the Gas Transmission Transportation Charging Methodology

NTS GCD 01:

Introduction of NTS Exit (Flat) Capacity Charges under the enduring offtake arrangements

20th October 2006

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Executive Summary

This document sets out for discussion National Grid NTS's proposed options for amending the Gas Transmission Transportation Charging Methodology (the "Charging Methodology") in respect of the setting of NTS Exit (Flat) Capacity Prices from 1st October 2010. This would be required in the event of implementation of UNC Modification 0116 ("Introduction of NTS Offtake arrangements"), which would make available an NTS Exit (Flat) Capacity product to all Users as part of the enduring offtake arrangements.

The proposed NTS Exit (Flat) Capacity product would provide Users the ability to obtain rights to offtake a daily quantity of gas at an NTS Exit Point, with the implied right to offtake at an even flow rate across the Gas Day. NTS Exit (Flat) Capacity is proposed to be made available at an NTS Exit Point to Users in the following bundles of daily rights:

- "Prevailing NTS Exit (Flat) Capacity" - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User for each Gas Day in every Gas Year. Users will be able to apply for such rights in July of Gas Year Y for Gas Year Y+4 onwards;
- "Annual NTS Exit (Flat) Capacity" - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User for each Gas Day in a Gas Year. Users will be able to bid for such rights in August of Gas Year Y for Gas Years Y+1, Y+2 and Y+3 via annual auctions, with such bid prices not being less than the annual reserve price;
- "Daily NTS Exit (Flat) Capacity" - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User for a Gas Day only. Users will be able to bid for such rights ahead of and during the Gas Day via daily auctions, with such bid prices not being less than the daily firm reserve price; and
- "Daily Interruptible NTS Exit (Flat) Capacity" **-** Interruptible NTS Exit (Flat) Capacity which may be applied for and registered as held by a User for a Gas Day only. Users will be able to bid for such rights ahead of the Gas Day via daily auctions, with such bid prices not being less than the daily interruptible reserve price.

The methodology for setting capacity charges has been the subject of significant debate as part of the Gas Transmission Charging Methodology Forum (Gas TCMF). As a consequence of the work carried out within the Gas TCMF, as documented in the Gas TCMF Progress Report published on the National Grid industry website, National Grid NTS has developed a number of options for determining entry and exit capacity charges. It is National Grid NTS's intention to formally consult on its proposed option in due course. This is expected to be based on a move towards a Transportation Model for setting both entry and exit capacity charges. Recognising this forthcoming consultation, and the potential for any charging consultation to be vetoed by the Authority, this discussion paper sets out two potential options for setting charges for NTS Exit (Flat) Capacity under the enduring arrangements, to support consultation on the UNC Modification Proposal 0116:

Option 1: Transportation Model "Preferred Option"

- A Transportation Model is used for estimating Long Run Marginal Costs (LRMCs) for the purposes of determining Prevailing NTS Exit (Flat) Capacity prices and reserve prices for annual and daily firm NTS Exit (Flat) Capacity auctions based on a single year network model and supply/demand forecast for the relevant Gas Year;
    - For Prevailing NTS Exit (Flat) Capacity, charges will be set for the forthcoming Gas Year based on the supply/demand forecast and network model for that year;

- For annual reserve prices, the reserve price for Gas Year Y+"n" will be set based on the supply/demand forecast and network model for year "n";
- For daily firm reserve prices, the reserve price will be set based on the Prevailing NTS Exit (Flat) Capacity charge in place for that Gas Day.

Option 2: Transcost Model "Alternative option"

- Transcost Model is used for estimating Long Run Marginal Costs (LRMCs) for the purposes of determining NTS Exit (Flat) Capacity prices from 1st October 2010 based on a ten year supply/demand forecast and a network model from the relevant gas year;
  - For Prevailing NTS Exit (Flat) Capacity, charges will be set for the forthcoming Gas Year based on a weighted average of 10 network analyses (as under current arrangements);
  - For annual reserve prices, the reserve price for Gas Years Y+1, Y+2 and Y+3 will be set based on the Prevailing NTS Exit (Flat) Capacity for the following Gas Year Y+1;
  - For daily firm reserve prices, the reserve price will be set based on the Prevailing NTS Exit (Flat) Capacity charge in place for that Gas Day.

However the following proposals are common to use of either the Transportation or Transcost model options:

- The current Interruption payments will be removed as a result of the removal of the interruptible site status;
- The supply/demand forecast used will include all firm demand recognising the proposed removal of interruptible status from 1st October 2010;
- The Reserve Price for Daily Interruptible NTS Exit (Flat) Capacity will attract a 100% discount i.e. would be set at zero price;
- The Tariff Model, by which LRMCs are converted into entry and exit prices, will preserve locational differentials between NTS Exit Points within the price determination process but will not adjust prices to recover allowed TO revenue;
- There will be no capping of annual movements in capacity prices;
- Charges will be set for each NTS Exit Point consistent with the definition of the NTS Exit (Flat) Capacity product i.e. removal of zones for NTS/LDZ offtakes.

It is envisaged that any changes to the Charging Methodology associated with the purchase of the NTS Exit (Flat) Capacity for use from 1st October 2010 would be needed by July 2007, although payment of any revised charges would not occur until 2010.

Following the conclusion of this pricing discussion consultation and the Gas Charging Review being carried out through the Gas TCMF, National Grid NTS intends to bring forward a modification to its transportation charging methodology and will raise such a proposal and consult formally with the industry.

A number of other transportation charging methodology modifications will be required to support implementation of UNC Modification Proposal 0116, were it to be approved. These issues are discussed in related discussion papers numbered 'NTS GCD 02' and 'NTS GCD 03' both of which may have a bearing on this pricing consultation. Respondents are therefore requested to review this document in the context of wider transportation charging methodology change discussion.

1 Introduction

1.1 National Grid NTS has proposed UNC Modification Proposal 0116 "Reform of the NTS Offtake Arrangements" in respect of the release of exit capacity for utilisation from 1 October 2010. In the event that this proposal was implemented, National Grid NTS would make available a capacity product referred to in the proposal as "NTS Exit (Flat) Capacity". This would be released via an application process for use in the unconstrained period (i.e. beyond investment lead times) as a Prevailing NTS Exit (Flat) Capacity right (which would be automatically renewed each Gas Year) and annual and daily NTS Exit (Flat) Capacity rights via auctions for use in the constrained period.

1.2 In light of the development of this product, National Grid NTS is required by Standard Licence Condition A4 of its GT Licence to consider any associated changes to the Gas Transmission Transportation Charging Methodology (the "Charging Methodology"). This paper sets out, for discussion, proposals in respect of:

- the setting of prices for Prevailing NTS Exit (Flat) Capacity; and
- the setting of Reserve Prices for both annual and daily auctions of NTS Exit (Flat) Capacity.

1.3 The methodology for setting capacity charges has been the subject of significant debate as part of the Gas Transmission Charging Methodology Forum (Gas TCMF). As a consequence of the work carried out within the Gas TCMF, as documented in the Gas TCMF Progress Report published on the National Grid industry website, National Grid NTS has developed a number of options for determining entry and exit capacity charges. It is National Grid NTS's intention to formally consult on its proposed option in due course. This is expected to be based on a move towards a Transportation Model for setting both entry and exit capacity charges. Recognising this forthcoming consultation, and the potential for any charging consultation to be vetoed by the Authority, this discussion paper sets out two potential options for setting charges for NTS Exit (Flat) Capacity under the enduring arrangements.

1.4 It is envisaged that changes to the charging structure associated with the purchase of NTS Exit (Flat) Capacity will be needed in time for the first annual applications in July 2007 for Prevailing NTS Exit (Flat) Capacity for utilisation from October 2010 onwards. Annual auctions of NTS Exit (Flat) Capacity will commence in August 2008 and daily auctions from 1 October 2010.

1.5 It should be noted that this charging discussion paper is consistent with the legal text included within UNC Modification 0116. Changes to the NTS Exit (Flat) Capacity product that may arise during the consultation on UNC Modification 0116 may impact the proposed methodologies described in this paper. This will be accommodated in any formal pricing consultations put forward by National Grid NTS after consideration of views to this document.

2 Background

Current Exit Capacity Charging Arrangements

Transcost Model

2.1 Under the current regime, Shippers at NTS Supply Points and Connected System Exit Points (CSEPs) book a bundled product ("NTS Exit Capacity") for both its within day and end of day requirements. Shippers pay for any booked NTS Exit Capacity for a Gas Day at a charge rate as set out in the Transportation Statement for that Gas Day. These charges tend to be published for a Gas Year, but can be updated during each year.

2.2 NTS exit capacity charges are currently based upon the estimated long run marginal cost (LRMC) of reinforcing the system to transport additional gas between entry and exit points. A model, known as Transcost, has been developed by National Grid NTS to estimate LRMCs to support the setting of NTS exit capacity charges. The LRMC approach derives forward-looking charges, which are intended to provide economically efficient signals to system Users. The LRMC calculation uses the supply/demand match set out in the Base Plan Assumptions from the 10 Year Statement and the reinforcement plans that are derived from it. Transcost first constructs a base network that is just sufficient to support the supply/demand match for year 1 of the analysis. This will equate to the present network plus any known reinforcement projects that will be completed before year 1 begins. For each subsequent year of the analysis, Transcost will reinforce the modelled network from the previous year so that it is just sufficient to support the supply/demand match for that year. There are therefore ten separate but related networks to be used in the analysis.

Zones

2.3 NTS exit capacity charges are administered on an aggregated zonal basis for the Distribution Network offtakes (nodal for NTS direct connects)

Revenue Recovery

2.4 NTS exit capacity charges are administered with the aim of recovering 50% of National Grid NTS's TO allowable revenue, with the remaining 50% to be recovered from NTS entry charges.

Price capping

2.5 In addition, the existing methodology constrains any re-balancing of exit prices with the latest LRMC calculations. The re-balancing rules compare the latest prices with charges over the last two years, and smooth any changes, with movement limited by a given percentage (+/- 30% in 2001).

Interruptible Capacity

2.6 At present, exit capacity charges are applied only in respect of firm loads. Interruptible capacity is available for supply points with annual quantities of over 5,860 MWh per annum at a zero price. For supply points that have been nominated by a User as interruptible, the User will not pay the NTS exit capacity charge and where National Grid NTS nominates a supply point to be interrupted for more than 15 days in a particular year (measured from 1 April to 31 March) there is a transportation charge credit.

NTS Exit Capacity Charge Re-balancing

2.7 PC761 which was implemented in December 2002, proposed that the pre-existing balance of exit capacity charges should be maintained until NTS exit reform is introduced. Furthermore, in previous years, changes to the administered exit prices were constrained by agreed mechanisms consulted on in PD22, PD63, PD114 and PC715. Since over the years there have been significant changes to the NTS and to the flows of gas on the system, the capacity charges currently applied do not necessarily reflect the latest LRMCs. In some cases, this divergence between the present charges and the latest LRMCs is quite significant.

Charging Review

2.8 In January 2006 National Grid NTS instigated a review of the gas transmission transportation charging arrangements with the industry via the launch of the Gas Transmission Charging Methodology Forum (Gas TCMF).

2.9 One of the key areas of the review has been the methodology by which entry and exit capacity prices are determined, and the information made available to the industry to understand and replicate the price setting process. This was instigated by Ofgem's open letter of 2nd December 2005, in which Ofgem suggested that National Grid NTS develop a charging model which is made available to the industry such that Users can repeat the price setting process. A single model for determination of all Entry and Exit capacity prices was stated to be desirable.

2.10 As a consequence of the work carried out within the Gas TCMF, National Grid NTS has identified its preferred option of introducing a Transportation Model as the basis for calculating all NTS Capacity prices from 1st April 2007.

Options and Analysis

2.11 Options for modifying the Charging Methodology to take into account exit reform were consulted on in 2005 in pricing discussion papers PD18, PD19 and PD20. Concerns were raised regarding the LRMC methodology through this consultation process, particularly in regard to the stability and transparency of the price determination methodology. National Grid NTS has sought to address similar concerns raised through the Gas TCMF through development of a single year Transportation model and associated tariff model changes.

2.12 The options presented in regard to NTS Exit (Flat) Capacity in PD18 were;

- Use the latest LRMC based UCAs;
- Establish a capping or smoothing mechanism (either on a transitional or enduring basis) to move from the current administered prices towards the latest LRMCs/UCAs;
- Align entry and exit UCAs/reserve prices by delaying the implementation of the latest LRMCs for exit reserve prices until new entry UCAs are reviewed.

[1] PC76 NTS TO Entry Capacity Auction Reserve Prices and Exit Charges – November 2002

[2] PD2 1998 NTS Capacity Charge Rebalancing – May 1998

[3] PD6 1999 NTS Capacity Charge Rebalancing – May 1999

[4] PD11 2000 NTS Capacity Charge Rebalancing – July 2000

[5] PC71 NTS Transmission Asset Owner Charges – November 2001

2.13 In light of Ofgem's desire to de-link Entry UCAs from NTS Entry Capacity Reserve Prices, as stated in Ofgem's open letter of 2nd December 2005, it would seem inappropriate to link Exit UCAs to NTS Exit Capacity prices.

2.14 The concept of using LRMCs has been discussed through the Gas TCMF process and the development of the Transportation model and associated Tariff model proposals, while focussed on Transitional Exit price determination, are consistent with the enduring arrangements.

2.15 National Grid NTS, as stated within the Gas TCMF process, considers that the Transportation model is ideally suited to enduring exit arrangements as it only takes into account the pipe network and the supply/demand scenario, the fundamentals of gas transmission, and does not take into account system planning pressures which drive the quantity of system flexibility.

2.16 National Grid NTS continues to consider that LRMC based exit charges (for the NTS Exit (Flat) Capacity product) are most appropriate and that the methodology resulting from the implementation of its preferred Transportation model option is appropriate for the enduring exit arrangements. The key considerations are therefore;

- the treatment of forecast demand within the process;
- the recovery of TO allowed revenue given the move from administered prices to auction reserve prices, and
- the treatment of interruptible capacity

UNC Modification Proposal 116 – "Reform of the NTS Offtake Arrangements"

2.17 UNC Modification Proposal 0116 "Reform of the NTS Offtake Arrangements" proposes that common exit capacity products and registration processes are made available to all Users under the enduring offtake arrangements, commencing operation from 1 October 2010. Both an NTS Exit (Flat) Capacity product and an NTS Exit (Flexibility) Capacity product are proposed as described below:

- **"NTS Exit (Flat) Capacity"** - to provide Users the ability to obtain rights to offtake a daily quantity of gas at an NTS Exit Point, with the implied right to offtake at an even flow rate across the Gas Day. This in effect extends the current NTS Offtake (Flat) Capacity available to DNO Users at NTS/LDZ Offtakes to all Users and all NTS Exit Points. Such a product is anticipated to provide National Grid NTS with clear locational signals for where, when and how much transportation capability may be required by Users to support anticipated end of day demand, and will facilitate efficient NTS investment planning and operation;

- **"NTS Exit (Flexibility) Capacity"** - to provide Users the ability to obtain rights to offtake gas in aggregate over a Gas Day at one or more NTS Exit Points within an NTS Exit Zone (to be defined in the enduring ExCR Methodology Statement) at flow rates which deviate from the even flow rate conferred through holding NTS Exit (Flat) Capacity. Actual utilisation of NTS Exit (Flexibility) Capacity for each User at each NTS Exit Zone on each Gas Day will be determined by subtracting 2/3 of its total end of day allocated quantity from the cumulative allocated quantity it has offtaken between 06:00 and 22:00, including a tolerance of 1.5% on measurements of the cumulative flow. This in effect extends the current NTS Offtake (Flexibility) Capacity available to DNO Users at NTS/LDZ Offtakes to all Users and all NTS Exit Points within NTS Exit Zones. Such a product is anticipated to allow Users to compete, on a non-discriminatory basis, for constrained amounts of within day system capability that National Grid NTS will make available in accordance with its Licence obligations and incentives. In addition, this product, in the context of the proposed regime, will allow National Grid NTS to better manage the system, particularly in the context for large and/or unexpected within day flow rate variations. Charging proposals to support the introduction of this product are considered in discussion paper GCD 02.

Release of NTS Exit (Flat) Capacity

2.18 The NTS Exit (Flat) Capacity product is proposed to be made available well ahead of the Gas Day in annual bundles of daily rights so that an efficient allocation process can be operated whilst avoiding the potential complexity of providing sub-annual products. The release of daily and within-day Capacity should enable Users to fine-tune its requirements closer to gas flow, and particularly should satisfy the specific needs of counter seasonal loads, such as Storage Operators.

2.19 The following classes of NTS Exit (Flat) Capacity will be made available to Users:

- **"Prevailing NTS Exit (Flat) Capacity"** - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User at a relevant NTS Exit Point for each Gas Day in every Gas Year unless the User provides a notice to reduce its prevailing rights;
- **"Annual NTS Exit (Flat) Capacity"** - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User at a relevant NTS Exit Point for each Gas Day in a Gas Year;
- **"Daily NTS Exit (Flat) Capacity"** - Firm NTS Exit (Flat) Capacity which may be applied for and registered as held by a User at a relevant NTS Exit Point for a Gas Day only; and
- **"Daily Interruptible NTS Exit (Flat) Capacity"** - Interruptible NTS Exit (Flat) Capacity which may be applied for and registered as held by a User at a relevant NTS Exit Point for a Gas Day only.

Release of Annual NTS Exit (Flat) Capacity

2.20 It is proposed that "pay-as-bid" auctions will be held in August of each Gas Year Y to provide Users the opportunity to seek to procure annual NTS Exit (Flat) Capacity rights for Gas Years Y+1, Y+2 and Y+3.

Release of Daily Firm NTS Exit (Flat) Capacity

2.21 Daily Firm NTS Exit (Flat) Capacity will be made available through “pay-as-bid” auctions held ahead of the Gas Day at 15.00 and during the Gas Day at 08:00, 14:00, 18:00 and 01:00. National Grid NTS will also be able to hold additional auctions at its discretion by inviting Users to participate in such an auction with at least 60 minutes notice.

Release of Daily Interruptible NTS Exit (Flat) Capacity

2.22 It is proposed that daily Interruptible NTS Exit (Flat) Capacity will be made available at 15:00 ahead of the Gas Day through a “pay-as-bid” allocation process. The quantity to be offered will be determined as:

- **a Use-it-or-Loose-It (UIOLI) amount** - the difference between the firm NTS Exit (Flat) Capacity holdings at the NTS Exit Point and the quantity of NTS Exit (Flat) Capacity that is expected to be utilised by Users for the purposes of facilitating gas flows (assessed from a rolling average over a 30 day period from D-36 to D-7 inclusive); and
- **Discretional Amount** - any additional amount that National Grid NTS may make available at its discretion.

3 Proposed Methodologies

This section outlines two potential options for setting of charges in respect of NTS Exit (Flat) Capacity. In the event that a Charging Methodology proposal based on option 1 or option 2 was implemented, Appendix C presents indicative NTS Exit (Flat) Capacity prices that would be in place from 1st October 2010.

Option 1 – Transportation Model Based Approach

Transport Model

It is proposed that:

3.1 NTS Exit (Flat) Capacity Prices are determined from a Transportation Model that calculates the Long Run Marginal Costs (LRMCs) of transporting gas from each entry point (for the purposes of setting NTS Entry Capacity Prices) to a "reference node"[6] and from the "reference node" to each relevant offtake point.

- The transportation model minimises the flow distance of gas around the network given the assumed pattern of supplies and demands and the constraint that at any node, demand plus flow out of the node must equal supply plus flow into the node.
- Any change in flow down a line results in a reinforcement requirement, with a standard reinforcement cost. It does not consider the way in which pressure, pipeline diameter / length and flow interact – it simply assumes that, for the standard reinforcement cost, incremental flow can be routed down each existing pipeline route. As a consequence the Transportation model excludes spare capacity and includes a backhaul benefit equal to the avoided cost of reinforcement
- The transportation model calculates the marginal costs of investment in the transmission system that would be required as a consequence of an increase in demand or supply at each connection point or node on the transmission system. The measure of the marginal investment costs is in terms of £/GWhkm, hence marginal changes in flow distances based on increases at entry and exit points are estimated initially in terms of increases or decreases in units of kilometres of the transmission system for a small energy injection to the system.

3.2 Prices for each Gas Year are calculated using the relevant year's 1-in-20 peak base case data and network model (e.g. if setting exit capacity prices for Gas Year 2010/11, the base case supply/demand forecast for 2010/11 and the base network model are used).

- For Prevailing NTS Exit (Flat) Capacity, charges will be set for the forthcoming Gas Year based on the supply/demand forecast and network model for that year;
- For annual reserve prices, the reserve price for Gas Year Y+"n" will be set based on the supply/demand forecast and network model for year "n";
- For daily firm reserve prices, the reserve price will be set based on the Prevailing NTS Exit (Flat) Capacity charge in place for that Gas Day.

[6] The reference node approach is a means of disaggregating route costs into entry and exit costs. The choice of reference node within the Transportation model does not affect the level of costs once an adjustment to fifty-fifty entry-exit costs has been made.

Tariff Model

It is proposed that:

3.3 For the purpose of setting reserve prices for use in capacity auctions the LRMCs calculated by the Transport Model are adjusted additively to target 50% costs at NTS Entry Points and 50% costs at NTS Exit Points. This will be achieved by ensuring the average positive values of the entry LRMCs equals the average positive values of the exit LRMCs.

3.4 Negative prices are removed as part of the adjustment step.

3.5 LRMCs are calculated from an Expansion Constant to represent the average cost of capacity per GWh km.

3.6 The Expansion Constant is determined from the average cost of incremental capacity for 100km of 900mm, 1050mm and 1200mm pipeline and recompression to 85 bar(g), calculated according to the methodology set out in Appendix A of this document.

Option 2 – Transcost Based Approach

It is proposed that:

3.7 NTS Exit (Flat) Capacity Prices are determined from the Transcost Model, which calculates the Long Run Marginal Costs (LRMCs) of transporting gas from each entry point to each relevant offtake point, as described within the prevailing Charging Methodology.

3.8 Transcost Model is used for estimating Long Run Marginal Costs (LRMCs) based on a ten year supply/demand forecast and a network model from the relevant gas year;

- For Prevailing NTS Exit (Flat) Capacity, charges will be set for the forthcoming Gas Year based on a weighted average of 10 network analyses (as under current arrangements);
- For annual reserve prices, the reserve price for Gas Years Y+1, Y+2 and Y+3 will be set based on the Prevailing NTS Exit (Flat) Capacity for the following Gas Year Y+1;
- For daily firm reserve prices, the reserve price will be set based on the Prevailing NTS Exit (Flat) Capacity charge in place for that Gas Day.

Tariff Model

It is proposed that:

3.9 For the purpose of setting reserve prices for use in capacity auctions the LRMCs derived from the Transcost Model route costs are disaggregated using the excel solver such that in aggregate 50% of route costs are targeted at NTS Entry Points and 50% costs at NTS Exit Points. This will be achieved by ensuring the average positive values of the entry LRMCs equals the average positive values of the exit LRMCs.

3.10 Negative prices are removed as the final step.

Common Proposals

3.11 The following would apply to both options 1 and 2 as described above.

Tariff Model

It is proposed that:

3.12 A single NTS Exit (Flat) Capacity price is calculated for each NTS Exit Point including both Directly Connected (DC) and Distribution Network (DN) NTS Exit Points. DN Exit zones will be removed from the Charging Methodology.

3.13 The Exit LRMCs are converted into prices using the Anuitisation Factor defined within National Grid's NTS Licence.

3.14 The adjusted annuitised prices are converted to units of p/kWh/day and then rounded to 4 decimal places.

3.15 For the purpose of setting NTS Exit (Flat) Capacity Prices that no adjustments to recover a fixed percentage of allowed TO revenue are made.

3.16 There is no year-on-year capping of prices.

3.17 The minimum price of 0.0001p/kWh/day would be applied; consistent with the prevailing Charging Methodology.

Interruption Payments

3.18 Modification Proposal UNC116 effectively removes interruptible status and interruptible capacity will only be purchased on a daily basis. Payments for interruption at interruptible supply points will therefore no longer be required.

3.19 The marginal cost of providing interruptible capacity is zero as there is no associated investment hence a 100% discount for daily Interruptible capacity would seem most appropriate.

3.20 Under the current exit reform proposals, from 1st October 2010, the NTS exit flat capacity product would be made available on a nodal basis and therefore auction reserve prices should also be determined and published at a nodal (NTS offtake) level.

It is proposed that:

3.21 The calculation of interruption payments is removed from the Charging Methodology, as interruption payments would be removed as a result of the implementation of Modification Proposal 0116.

3.22 Daily interruptible capacity is discounted by 100% relative to the Daily Capacity Price.

Implementation

It is proposed that:

3.23 These proposals are implemented to set NTS Exit (Flat) Capacity reserve prices from 1st August 2008.

3.24 NTS Exit (Flat) Capacity Prices are updated annually using the base supply/demand forecast, network model and list of sanctioned projects known at the time of calculation. In practice, we anticipate revised entry prices would be published each July (before the annual QSEC auctions) for application to all capacity sold from 1 October that year onwards.

4 Questions for Consultation

National Grid NTS invites views on whether the proposed options to change our Charging Methodology achieve National Grid NTS's relevant GT Licence objectives (as outlined in Appendix B), specifically that:

Q1. LRMCs are calculated from either a Transportation model of the NTS or are calculated from Transcost.

Option 1 – Transportation Model Based Approach

Q2. LRMCs are calculated from a Transportation model of the NTS, consequentially excluding spare capacity and including a backhaul benefit equal to the avoided cost of reinforcement.

Q3. NTS Exit (Flat) Capacity Prices are determined separately for each gas year from analysis of a single year Supply & Demand forecast using the relevant Gas Year's base case data and network model for the capacity released.

Q4. Entry and exit LRMCs be calculated from the cost from a "reference node" to each relevant offtake point and the cost from each entry point to the "reference node" and that the LRMCs is adjusted to give a 50:50 split between average positive value of these adjusted Entry & Exit costs;

Option 2 – Transcost Based Approach

Q5. LRMCs are calculated from Transcost, consequentially including spare capacity and excluding any backhaul benefit.

Q6. NTS Exit (Flat) Capacity Prices and auction reserve prices for all relevant Gas years are determined from a single weighted average analysis of the ten year Supply & Demand forecast using the current Gas Year's base model.

Q7. Entry and exit LRMCs be calculated from route costs associated with an incremental flow of 2.834 Mscm[7] for every combination of entry and exit point and that the route LRMCs are disaggregated into entry and exit LRMCs using an excel based solver constrained to give a 50:50 split between average positive values of these adjusted Entry & Exit costs;

[7] The use of the 2.384 Mscm (100 Mscf) increment represents approximately 10% of flow down a typical NTS feeder and is unchanged from the prevailing methodology.

Common Proposal Features

Q8. Prices are set at a nodal level rather than an exit Zone level for all NTS Exit points.

Q9. Exit LRMCs are converted into prices using the anuitisation factor set out in National Grid's NTS Transportation Licence.

Q10. No year-on-year capping of NTS Exit Capacity prices is included in the methodology.

Q11. Interruptible NTS Exit (Flat) Capacity Prices are discounted by 100%

The closing date for submission of your responses is **Friday 24th November 2006**.

Your response should be e-mailed to jan.gascoigne@uk.ngrid.com or alternatively by post to Jan Gascoigne, Regulatory Frameworks, National Grid, National Grid House, Gallows Hill, Warwick, CV34 6DA. If you wish to discuss any matter relating to this charge methodology consultation then please call Eddie Blackburn☎ 01926 656022.

Responses to this consultation will be incorporated within National Grid NTS's conclusion report. If you wish your response to be treated as confidential then please mark it clearly to that effect.

Appendix A – Expansion Constant Calculation

1. Expansion Constants are utilised in the Transportation Model to represent the estimated typical capital cost of the transmission infrastructure required to transport 1 peak day GWh over 1 km. The incremental cost is then determined by multiplying pipe lengths by the appropriate expansion constant. Table A-1 below provides the expansion constants for 900mm, 1050mm and 1200mm pipe diameter based on the following assumptions:
   (a) latest forecast cost of pipelines;
   (b) 100km feeder duplication (parallel pipeline, same diameter) i.e. assumes compressor required every 100km on average;
   (c) maximum inlet pressure per pipe section of 85bar;
   (d) optimum outlet pressure per pipe diameter with a minimum of 38 bar
2. Project management costs are included in the figures and are based on 15% of investment costs.
3. Operating costs of 1.5% are factored into the current Licence anuitisation factor of 0.10772.
4. The single expansion constant for use in the Transportation model is based on an average of the expansion constants for pipe diameters of size 900 to 1200mm typically used over recent years and planned to be built to reinforce the system.

Table A-1: Estimated Investment Costs (September 2006)

Description	Cost (£M)
Pipeline (per km length)	0.0012507 × diameter (mm) - 0.01507
Compressor – existing site (per MW)	0.875

Table A-2: Expansion constants used in the Transportation Model (September 2006)

Pipe Diameter (mm)	A Pipe Cost (£M)	B Compressor Cost (£M)	C Maximum Capacity (GWh)	$=10^6*((A+B)/C)/100$ Expansion constant (£/GWhkm)
1200	148.58	49.59	1069	1853
1050	129.82	40.82	783	2179
900	111.06	32.37	544	2635
Average				2223

Investment Cost Methodology

5. This methodology utilises the costs from all NTS investment work carried out over an 8 year period, including NTS investment work carried out during the previous 4 years in addition to the NTS investment planned for the next 4 years. If there are fewer than 5 projects for a particular diameter of pipeline, the number of years' worth of data being considered to determine the formula will be extended.
6. Linear regression techniques will be used to determine the best fitting trend line to allow for the prediction of the pipeline cost as a cost per kilometre using the diameter of the pipeline in mm as the independent variable.

7. The project investment costs will then be adjusted by applying the Structural Steelwork Labour Costs price index to take into account the rates of change in the provision of network infrastructure, such as steel prices, construction costs and general inflation. This index is available from the DTI via their website. www.DTI.Gov.UK/construction/stats This process will produce costs per kilometre and per megawatt of compressive power which relate to the appropriate construction year.
8. The pipe cost data from the various investment projects will be plotted on a scatter graph showing pipeline diameter versus calculated cost per metre. A trend line will be added to the graph to provide the best fit and allows a new formula to be derived for predicting pipeline costs per kilometre.
9. The compressor cost data from the various investment projects will be averaged to allow a new formula to be derived for predicting compressor unit costs per MW of compressive power.
10. The final pipe cost formula derived from this process is in the form:-

    Cost (£M/km) = a * diameter (mm) + b / km
11. The pipe cost constants ‘a’ and ‘b’ will be established by National Grid NTS each year using investment data as specified above and will be specified to 6 decimal places.
12. The results from applying this methodology including the compressor unit cost and values ‘a’ and ‘b’ will be released by National Grid NTS when new prices are published.

Appendix B - Relevant Objectives

Licence Relevant Objectives

The National Grid Gas plc Gas Transporter Licence in respect of the NTS requires that proposed changes to the Charging Methodology shall achieve the relevant methodology objectives. The relevant objectives are outlined in the following sections:

Where transportation prices are not established through an auction, prices calculated in accordance with the methodology should:

1) Reflect the costs incurred by the licensee in its transportation business;
2) So far as is consistent with (1) properly take account of developments in the transportation business;
3) So far as is consistent with (1) and (2) facilitate effective competition between gas shippers and between gas suppliers.

Where prices are established by means of auctions, either

4) No reserve price is applied or
5) Reserve prices are calculated at a level that promotes efficiency, avoids undue preference in the supply of transportation services and promotes competition between gas shippers and between gas suppliers.

National Grid NTS is obliged to keep the NTS Charging Methodology under review at all times for the purposes of ensuring that it achieves the relevant objectives.

EU Gas Regulations

EC Regulation 1775/2005 on conditions for access to the natural gas transmission networks (binding from 1 July 2006) states that the principles for network access tariffs or the methodologies used to calculate them shall:

- Be transparent
- Take into account the need for system integrity and its improvement
- Reflect actual costs incurred for an efficient and structurally comparable network operator
- Be applied in a non-discriminatory manner
- Facilitate efficient gas trade and competition
- Avoid cross-subsidies between network Users
- Provide incentives for investment and maintaining or creating interoperability for transmission networks
- Not restrict market liquidity
- Not distort trade across borders of different transmission systems.

All but the last of the principles listed above map onto the objectives for National Grid's Transmission Transportation Charging Methodology. In terms of cross border trade, the Regulation recognises that funding for network investment may require different tariffs across different transmission systems.

Appendix C – Indicative NTS Capacity Prices for 1st October 2010

Introduction

This appendix sets out the indicative NTS TO Exit (Flat) Capacity prices which would apply from 1st October 2010 for the use of the NTS. These prices have been calculated based on the prevailing Licence anuitisation factor.

Units

Capacity prices are expressed and billed in pence per peak day kilowatt hour per day.

NTS Exit Capacity Prices

NTS TO Exit (Flat) Capacity prices apply to NTS offtakes into Distribution Networks (DNs) and to large loads and interconnectors supplied directly from the NTS.

Table C1 Indicative DN NTS TO Exit (Flat) Capacity Prices

			Transportation Model			Transcost
LDZ	Network	Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
EA1	East of England	Bacton	0.0001	0.0001	0.0001	0.0001
EA1	East of England	Brisley	0.0001	0.0001	0.0001	0.0001
EA1	East of England	Peterborough Eye	0.0022	0.0022	0.0017	0.0001
EA1	East of England	West Winch	0.0023	0.0023	0.0018	0.0001
EA2	East of England	Great Wilbraham	0.0051	0.0051	0.0046	0.0001
EA2	East of England	Roundham Heath	0.0016	0.0016	0.0010	0.0010
EA3	East of England	Yelverton	0.0001	0.0001	0.0001	0.0001
EA4	East of England	Cambridge	0.0129	0.0129	0.0124	0.0001
EA4	East of England	Matching Green	0.0100	0.0100	0.0094	0.0001
EA4	East of England	Royston	0.0069	0.0069	0.0063	0.0001
EA4	East of England	Whitwell	0.0087	0.0087	0.0082	0.0023
EM1	East of England	Thornton Curtis	0.0001	0.0001	0.0001	0.0001
EM1	East of England	Walesby	0.0001	0.0001	0.0001	0.0001
EM2	East of England	Blyborough	0.0001	0.0001	0.0001	0.0001
EM2	East of England	Gosberton	0.0001	0.0001	0.0001	0.0001
EM2	East of England	Kirkstead	0.0001	0.0001	0.0001	0.0001
EM2	East of England	Silk Willoughby	0.0001	0.0001	0.0001	0.0001
EM2	East of England	Sutton Bridge	0.0009	0.0009	0.0004	0.0001
EM3	East of England	Alrewas	0.0091	0.0091	0.0086	0.0001
EM3	East of England	Blaby	0.0058	0.0058	0.0053	0.0001
EM3	East of England	Drointon	0.0102	0.0102	0.0075	0.0020
EM3	East of England	Tur Langton	0.0048	0.0048	0.0042	0.0001
EM4	East of England	Caldecott	0.0035	0.0035	0.0030	0.0001
EM4	East of England	Market Harborough	0.0046	0.0046	0.0041	0.0001
NE1	North of England	Asselby	0.0001	0.0001	0.0001	0.0033
NE1	North of England	Baldersby	0.0007	0.0007	0.0002	0.0102
NE1	North of England	Burley Bank	0.0003	0.0003	0.0001	0.0100
NE1	North of England	Pannal	0.0001	0.0001	0.0001	0.0100

			Transportation Model			Transcost
LDZ	Network	Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
NE1	North of England	Rawcliffe	0.0001	0.0001	0.0001	0.0028
NE1	North of England	Towton	0.0001	0.0001	0.0001	0.0100
NE2	North of England	Ganstead	0.0001	0.0001	0.0001	0.0001
NE2	North of England	Paull South	0.0001	0.0001	0.0001	0.0001
NE2	North of England	Pickering	0.0001	0.0001	0.0001	0.0001
NE3	North of England	Paull North	0.0001	0.0001	0.0001	0.0001
NO1	North of England	Bishop Auckland	0.0005	0.0005	0.0001	0.0103
NO1	North of England	Coldstream	0.0001	0.0001	0.0001	0.0152
NO1	North of England	Corbridge	0.0001	0.0001	0.0031	0.0103
NO1	North of England	Cowpen Bewley	0.0001	0.0001	0.0001	0.0103
NO1	North of England	Elton	0.0001	0.0001	0.0001	0.0103
NO1	North of England	Guyzance	0.0001	0.0001	0.0007	0.0103
NO1	North of England	Humbleton	0.0001	0.0001	0.0001	0.0104
NO1	North of England	Little Burdon	0.0001	0.0001	0.0001	0.0103
NO1	North of England	Saltwick	0.0001	0.0001	0.0019	0.0104
NO1	North of England	Thrintoft	0.0010	0.0010	0.0005	0.0102
NO2	North of England	Keld	0.0025	0.0025	0.0033	0.0056
NO2	North of England	Melkinthorpe	0.0018	0.0018	0.0040	0.0056
NO2	North of England	Tow Law	0.0023	0.0023	0.0018	0.0056
NO2	North of England	Wetheral	0.0001	0.0001	0.0064	0.0056
NT1	London	Winkfield NT	0.0143	0.0143	0.0138	0.0177
NT2	London	Horndon	0.0095	0.0095	0.0090	0.0001
NT2	London	Luxborough Lane	0.0097	0.0097	0.0092	0.0001
NT3	London	Peters Green	0.0091	0.0091	0.0086	0.0029
NW1	North West	Blackrod	0.0105	0.0105	0.0064	0.0217
NW1	North West	Lupton	0.0050	0.0050	0.0008	0.0056
NW1	North West	Samlesbury	0.0091	0.0091	0.0050	0.0188
NW2	North West	Audley NW	0.0104	0.0083	0.0042	0.0054
NW2	North West	Eccleston	0.0126	0.0105	0.0063	0.0227
NW2	North West	Holmes Chapel	0.0092	0.0071	0.0030	0.0055
NW2	North West	Malpas	0.0122	0.0101	0.0059	0.0187
NW2	North West	Mickle Trafford	0.0119	0.0098	0.0057	0.0250
NW2	North West	Partington off	0.0080	0.0059	0.0017	0.0056
NW2	North West	Warburton	0.0077	0.0056	0.0015	0.0056
NW2	North West	Weston Point	0.0128	0.0107	0.0066	0.0250
SC1	Scotland	Aberdeen	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	Balgray	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	Careston	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	Kinnockie	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	Mosside	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	Pitcairn	0.0001	0.0001	0.0001	0.0054
SC1	Scotland	St Fergus	0.0001	0.0001	0.0001	0.0054
SC2	Scotland	Armadale	0.0001	0.0001	0.0001	0.0054

			Transportation Model			Transcost
LDZ	Network	Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
SC2	Scotland	Broxburn	0.0001	0.0001	0.0001	0.0152
SC2	Scotland	Hume	0.0001	0.0001	0.0001	0.0152
SC2	Scotland	Soutra	0.0001	0.0001	0.0010	0.0152
SC4	Scotland	Bathgate	0.0001	0.0001	0.0001	0.0054
SC4	Scotland	Drum	0.0001	0.0001	0.0001	0.0054
SC4	Scotland	Glenmavis offtake	0.0001	0.0001	0.0001	0.0054
SC4	Scotland	Langholm	0.0001	0.0001	0.0041	0.0056
SC4	Scotland	Lockerbie	0.0001	0.0001	0.0032	0.0056
SC4	Scotland	Nether Howcleugh	0.0001	0.0001	0.0014	0.0055
SC4	Scotland	Stranraer	0.0001	0.0001	0.0021	0.0055
SE1	South of England	Farningham	0.0114	0.0095	0.0104	0.0028
SE1	South of England	Shorne	0.0105	0.0085	0.0095	0.0011
SE1	South of England	Tatsfield	0.0130	0.0111	0.0121	0.0075
SE2	South of England	Winkfield SE	0.0143	0.0143	0.0138	0.0177
SO1	South of England	Hardwick	0.0093	0.0093	0.0088	0.0040
SO2	South of England	Braishfield	0.0177	0.0177	0.0171	0.0131
SO2	South of England	Ipsden	0.0124	0.0124	0.0118	0.0098
SO2	South of England	Mappowder	0.0133	0.0133	0.0128	0.0151
SO2	South of England	Winkfield SO	0.0143	0.0143	0.0138	0.0177
SW1	Wales and the West	Evesham	0.0022	0.0022	0.0017	0.0001
SW1	Wales and the West	Fiddington	0.0010	0.0010	0.0004	0.0001
SW1	Wales and the West	Ross SW	0.0002	0.0002	0.0001	0.0001
SW2	Wales and the West	Cirencester	0.0052	0.0052	0.0047	0.0028
SW2	Wales and the West	Easton Grey	0.0057	0.0057	0.0052	0.0017
SW2	Wales and the West	Ilchester	0.0113	0.0113	0.0108	0.0154
SW2	Wales and the West	Littleton Drew	0.0065	0.0065	0.0059	0.0035
SW2	Wales and the West	Pucklechurch	0.0073	0.0073	0.0068	0.0059
SW2	Wales and the West	Seabank LDZ	0.0091	0.0091	0.0086	0.0093
SW3	Wales and the West	Aylesbeare	0.0154	0.0154	0.0149	0.0279
SW3	Wales and the West	Kenn	0.0164	0.0164	0.0159	0.0284
SW3	Wales and the West	Lyneham	0.0179	0.0208	0.0203	0.0294
WA1	Wales and the West	Maelor	0.0130	0.0109	0.0067	0.0244
WA2	Wales and the West	Dowlais	0.0001	0.0001	0.0001	0.0001
WA2	Wales and the West	Dyffryn Clydach	0.0001	0.0001	0.0001	0.0001
WA2	Wales and the West	Gilwern	0.0001	0.0001	0.0001	0.0001
WM1	West Midlands	Aspley	0.0120	0.0099	0.0057	0.0052
WM1	West Midlands	Audley	0.0104	0.0083	0.0042	0.0054
WM1	West Midlands	Milwich	0.0108	0.0108	0.0069	0.0037
WM2	West Midlands	Alrewas WM	0.0091	0.0091	0.0086	0.0001
WM2	West Midlands	Austrey	0.0084	0.0084	0.0079	0.0001
WM2	West Midlands	Shustoke	0.0096	0.0096	0.0091	0.0009
WM3	West Midlands	Leamington	0.0046	0.0046	0.0041	0.0001
WM3	West Midlands	Lower Quinton	0.0032	0.0032	0.0027	0.0001

			Transportation Model			Transcost
LDZ	Network	Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
WM3	West Midlands	Ross WM	0.0002	0.0002	0.0001	0.0001
WM3	West Midlands	Rugby	0.0057	0.0057	0.0051	0.0001
WM3	West Midlands	Stratford Upon Avon	0.0033	0.0033	0.0028	0.0001

Table C2 Indicative NTS TO Exit (Flat) Capacity Prices (Direct Connects)

Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
AM Paper	0.0077	0.0056	0.0015	0.0056
Bacton I/C	0.0001	0.0001	0.0001	0.0001
Baglan Bay PG	0.0001	0.0001	0.0001	0.0001
Barking PG	0.0095	0.0095	0.0090	0.0001
BASF Teesside	0.0001	0.0001	0.0001	0.0103
BP Grangemouth	0.0001	0.0001	0.0001	0.0054
BP Saltend (HP)	0.0001	0.0001	0.0001	0.0001
Bridgewater Paper	0.0128	0.0107	0.0065	0.0250
Brigg PG	0.0001	0.0001	0.0001	0.0001
Brimsdown PG	0.0106	0.0106	0.0101	0.0001
Brunner Mond	0.0082	0.0061	0.0020	0.0062
Connahs Quay PG	0.0131	0.0110	0.0069	0.0250
Corby PG	0.0039	0.0039	0.0033	0.0001
Coryton PG	0.0097	0.0093	0.0087	0.0001
Cottam PG	0.0001	0.0001	0.0001	0.0001
Deeside PG	0.0127	0.0106	0.0065	0.0250
Didcot PG	0.0127	0.0127	0.0121	0.0082
Goole Glass	0.0001	0.0001	0.0001	0.0021
Great Yarmouth PG	0.0001	0.0001	0.0001	0.0001
Hays Chemicals	0.0097	0.0076	0.0035	0.0069
ICI Runcorn	0.0128	0.0107	0.0066	0.0250
Immingham CHP	0.0001	0.0001	0.0001	0.0001
Keadby PG	0.0001	0.0001	0.0001	0.0005
Kemira Ince	0.0125	0.0104	0.0062	0.0250
Kings Lynn PG	0.0026	0.0026	0.0021	0.0001
Kingsnorth PG	0.0092	0.0072	0.0082	0.0010
Little Barford PG	0.0058	0.0058	0.0053	0.0001
Langage_PG	0.0164	0.0164	0.0159	0.0294
Longannet PG	0.0001	0.0001	0.0001	0.0054
Medway PG	0.0093	0.0073	0.0083	0.0010
Moffat I/C	0.0001	0.0001	0.0021	0.0055
Peterborough PG	0.0026	0.0026	0.0021	0.0001
Peterhead PG	0.0001	0.0001	0.0001	0.0054
Phillips Seal Sands	0.0001	0.0001	0.0001	0.0103
Rocksavage PG	0.0128	0.0107	0.0066	0.0250
Roosecote PG	0.0017	0.0017	0.0001	0.0056
Rye House PG	0.0113	0.0113	0.0108	0.0001
Saltend PG	0.0001	0.0001	0.0001	0.0001
Sappi Paper Mill	0.0099	0.0099	0.0058	0.0188

Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
Seabank PG	0.0090	0.0090	0.0085	0.0092
Sellafield PG	0.0054	0.0054	0.0013	0.0056
Shotton Paper	0.0119	0.0098	0.0057	0.0250
Spalding PG	0.0001	0.0001	0.0001	0.0001
Stallingborough PG	0.0001	0.0001	0.0001	0.0001
Staythorpe PG	0.0010	0.0010	0.0005	0.0001
Sutton Bridge PG	0.0011	0.0011	0.0006	0.0001
Teesside Hydrogen	0.0001	0.0001	0.0001	0.0103
Teesside PG	0.0001	0.0001	0.0001	0.0103
Terra Billingham	0.0003	0.0003	0.0001	0.0103
Terra Severnside	0.0089	0.0089	0.0084	0.0092
Thornton Curtis PG	0.0001	0.0001	0.0001	0.0001
Zeneca	0.0001	0.0001	0.0001	0.0103

Table C3 Indicative NTS TO Exit (Flat) Capacity Prices (Storage)

	Transportation Model			Transcost
Offtake	2010/11 (Pence per kWh per day)	2011/12 (Pence per kWh per day)	2012/13 (Pence per kWh per day)	2007/8 (Pence per kWh per day)
Avonmouth	0.0090	0.0090	0.0085	0.0092
Barton Stacey (Humbly Grove)	0.0162	0.0162	0.0157	0.0126
Blyborough (Welton)	0.0001	0.0001	0.0001	0.0001
Burton Agnes (Caytorpe)	0.0001	0.0001	0.0001	0.0001
Cheshire	0.0078	0.0057	0.0015	0.0067
Dynevor Arms	0.0001	0.0001	0.0001	0.0001
Fleetwood	0.0032	0.0011	0.0001	0.0056
Garton	0.0001	0.0001	0.0001	0.0001
Glenmavis	0.0001	0.0001	0.0001	0.0054
Hatfield Moor	0.0001	0.0001	0.0001	0.0005
Holehouse farm	0.0091	0.0070	0.0029	0.0069
Hornsea	0.0001	0.0001	0.0001	0.0001
Partington	0.0080	0.0059	0.0017	0.0056
Rough	0.0001	0.0001	0.0001	0.0001
Tatsfield	0.0130	0.0111	0.0121	0.0075
Winkfield	0.0143	0.0143	0.0138	0.0177