Appendix A: Description of LDZ methodology

A1 Overview

The LDZ charging functions are based on the peak day consumption at a site rather than an explicit link to the pressure tier of the system to which the load is connected. This approach avoids inconsistencies that may arise if neighbouring sites, with similar peak day's quantities of gas consumed, are actually connected to different pressure tiers.

The methodology is based on average costs rather than marginal costs. Essentially the methodology involves the calculation of the average cost of using each of the main pressure tiers of the LDZ combined with the probability of a load of a given peak day quantity utilising each tier. The fitting of equations to these costs, using regression analysis, generates the charging functions.

- □ Charges for using the distribution system have a capacity and a commodity element with a 50:50 split both the capacity and commodity charges are functions of the peak day quantity.
- The probability of loads using the pressure tiers is derived from a survey of load connection and transportation information. The survey collated data on the tier of connection of a number of loads subdivided into a number of AQ consumption bands. The survey also collated the expected usage of higher tiers by loads exiting through lower tiers.
- □ The low pressure (LP) system is the largest asset group within the distribution system and a more detailed model is used which subdivides the pressure tier into a number of tiers categorised by pipe diameter.
- Once typical charge data for loads of a given size has been calculated, regression analysis is performed to determine continuous charging functions for unit rate capacity and commodity charges.

A2Tier Costs

The first step in calculating the charges is to identify the costs of each of the tiers. These costs are then scaled so that they sum to the target revenue for the LDZ. By calculating the relative costs of using the system the charges can then reflect these costs to generate the required revenue.

A2.1 Determination of Tier Costs

The LDZ networks contain a series of pipe networks split into four main pressure tiers:

A2.1.1 LDZ Pressure Tiers

| Pressure Tier | Operating Pressure |
|------------------------------------|---------------------------|
| Local Transmission System (LTS) | 7 – 38 bar |
| Intermediate Pressure System (IPS) | 2 - 7 bar |
| Medium Pressure System (MPS) | 75 mbar – 2 bar |
| Low Pressure System (LPS) | Below 75 mbar |

Not all the LDZs contain IPS pipelines. The Low Pressure System itself accounts for 220,000 km out of the total 270,000 km of LDZ pipeline.

In order to provide a more cost reflective basis for charging, the LP systems are subdivided, based on pipe diameter, into six sub-tiers as shown below.

| LP Tier | Metric Load Bands | Imperial Load Bands |
|---------|--------------------------|----------------------------|
| LP6 | <90mm | <4 inch |
| LP5 | 90- 125 mm | 4 to 5 inch |
| LP4 | 125mm to 180mm | 5 to 7 inch |
| LP3 | 180mm to 250mm | 7 to 10 inch |
| LP2 | 250mm to 355mm | 10 to 14 inch |
| LP1 | >355mm | >14 inch |

A2.1.2 Low <u>Pressure Sub-Tiers</u>

The direct flows into each sub tier are found from the distribution of flows across the pressure reduction stations. The flows out of each sub-tier are calculated from the sum of the connected loads. The inter-tier flows can then be calculated from the differences between flows into and flows out of each tier. From this data the probability of using each higher tier is calculated.

The total asset value is known for the Low Pressure system but not for each of the sub-tiers however the total replacement costs for all pipelines within each of the sub-tiers is known. The percentages of Total replacement costs for each sub-tier are shown in the following table and they are used within the methodology to attribute the total LP system cost to each of the sub-tiers.

| Tier | Pipe | Percentage of Total |
|------|------------|--------------------------|
| | Diameter | Replacement Costs |
| LP1 | >355mm | 12.3% |
| LP2 | 250- 355mm | 12.7% |
| LP3 | 180-250mm | 10.5% |
| LP4 | 125-180mm | 15.8% |
| LP5 | 90-125mm | 26.1% |
| LP6 | <=90mm | 22.6% |
| | Total | 100% |

A2.1.3 LP System Sub-Tier Replacement Costs

The principle underlying the LDZ charging methodology is that charges should reflect the average use of the network made by customers of a given size, rather than the actual use made by a particular customer. The latter methodology would be too complex to be a practical basis of charging. Analysis has shown that there is a good correlation between customer size and offtake tier. Large customers are typically supplied from higher-pressure tiers and small customers from lower pressure tiers. Such an approach avoids inconsistencies that may arise if neighbouring sites of similar size are actually connected to different pressure tiers.

| 2.1 | .4 Determination of Tie | r Cost | | |
|-----|-------------------------|---------|-----------|-------|
| | Pressure | | Cost (£M) | |
| | | % Total | | |
| | | ABC | | |
| | LTS | 15.7% | 193.8 | 96.9 |
| | IPS | 5.4% | 66.1 | 33.0 |
| | MPS | 16.2% | 198.8 | 99.4 |
| | LPS | 62.7% | 772.4 | 386.2 |

A2.1.4

TOTAL

The split of LPS costs down to sub-tier level is based on the total replacement cost of each sub-tier. Table A2.1.5 shows the percentage of the total LPS replacement cost attributable to each sub-tier. ABC data is not available on a sub-tier basis.

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| _ | | % Total Replacement Cost | Cost (£M) | |
|-------|-----------|--------------------------------|-----------|-------|
| LP1 | >355mm | 12.3% | 95.0 | 47.5 |
| LP2 | 250-355mm | 12.7% | 98.1 | 49.0 |
| LP3 | 180-250mm | 10.5% | 81.1 | 40.6 |
| LP4 | 125-180mm | 15.8% | 122.0 | 61.0 |
| LP5 | 90-125mm | 26.1% | 201.6 | 100.8 |
| LP6 | <90mm | 22.6% | 174.6 | 87.3 |
| TOTAL | | | 772.4 | 386.2 |

A2.1.5 **Determination of LP System Sub-Tier Cost**

A3 Capacity Cost Calculation

Capacity costs are based on peak day system utilisation by firm loads only.

A3.1 Probability of LDZ Tier Utilisation

Using the results from a survey of Supply Point connection data, the probability of a firm supply point being connected to an LDZ system tier has been calculated. The results, shown in Table A, are based on the 1999 Survey of the pressure tiers and the more detailed 2000 survey of the LP tier.

| Consumption | L | DZ Ti | LPS Sub Tiers | | | | | | | |
|-------------|-----|-------|---------------|-----|-----|-----|-----|-----|-----|--|
| Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | |
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A3.1.1 Table A - System Connection Probability Matrix

An extract from the Transco Sites & Meters database gives an estimate of the average SOQ within each of the consumption bands. Data has also been retrieved on the proportion of the connected load within each consumption band for both firm and interruptible total AQ and SOQ. This data has been used to break down the AQ and SOQ forecasts for winter 2002/3 from the 2001 SD statements into the appropriate load bands. Table B shows the peak daily consumptions for firm loads only.

A3.1.2 Table B - Peak Day Consumption by Annual Consumption Band

| Consumption Band (MWh) | Peak Day Consumption GWh |
|---------------------------|--------------------------------|
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By combining the probability of connection data (Table A) and the peak day Consumption (Table B), the volume of gas leaving each tier can be calculated for each consumption band.

| Consumption | LDZ Tiers | | | | LPS Sub Tiers | | | | | | |
|-------------|-----------|-----|-----|-----|---------------|-----|-----|-----|-----|--|--|
| Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | | |
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A3.1.3 Table C - Peak Day Volume (GWh's) Exiting Tier by Consumption Band

From network analysis it is possible to estimate the probability of a unit of gas having passed through the various pressure tiers/sub tiers within the LDZ network. This data is shown in Table D. If a supply point is connected to a given tier then the volume of gas exiting at that supply point must pass through that tier and hence all values on the matrix diagonal are 100%. Gas will always cascade down the pressure tiers and is assumed to cascade through the LP sub-tiers and hence for upward flows (above the diagonal) the probability is zero.

(NB. The assignment of letters to each table is consistent with previous descriptions of the methodology. Table D was previously calculated within the methodology but is not required within the calculation process and hence has been omitted.)

| Load Exiting | | Probability of Utilising Tier | | | | | | | | | |
|---------------------|-----|-------------------------------|-----|-----|-----|-----|-----|-----|-----|--|--|
| by Tier | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | | |
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A3.1.4 Table E – System Usage Probability Matrix by Tier

The peak day usage of each of the system tiers can be calculated from the sum of volumes exiting each tier multiplied by the probability of using each tier. This calculation represents the Matrix multiplication of Table C by Table E resulting in Table F.

[C]ij X [E]jk = [F]ik

Where

- i ~ Consumption Band
- j ~ Exit Tier
- k ~ Supply Tier

e.g. the volume of gas utilising the LTS and exiting to supply points within the 73.2 – 146.5 GWh/annum consumption band is calculated as;

| Load Exit Tier | |
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A3.1.5 Table F – Peak Day System Usage (GWh's) by Tier and Consumption Band

| | LI | LDZ Tiers | | | L | PS Sub Tiers | | | |
|-------------------------------|-----|-----------|-----|-----|-----|--------------|-----|-----|-----|
| Consumption Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 |
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| Consumption | LDZ Tiers LPS Sub Tiers | | | | | | | | |
|-------------|-------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 |
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A3.1.6 Table G - System Usage Probability Matrix

Table A3.1.6 shows that, for the 0-73.2 MWh consumption band, 97.8% of the total peak consumption (3,189 GWh from Table A3.1.2) goes through the LTS, 44.7% goes through the IPS, and 94.4% through the MPS.

A3.2 Average Cost of LDZ by Tier

Given the total cost and the total utilisation for each tier, the average utilisation cost of each tier can be calculated.

| LDZ T | 'iers | | LPS Sub Tiers | | | | | | | |
|-------|-------|-----|---------------|-----|-----|-----|-----|-----|--|--|
| LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | | |
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A3.2.1 Average LDZ Tier and Sub-Tier Costs

A3.3 Average Tier Costs by Consumption Band

The average costs for loads of a given size are then calculated for each tier from the average tier costs and the probability of the load using each tier. The total LDZ costs are then calculated from the sum of the individual tier costs.

| A3.3.1 | Average Cost of LDZ Utilisation by Consumption Band | | | | | | | | | | |
|--------|---|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-------|
| | Consumption | Pence /peak day kWh / Annum | | | | | | | | | |
| | Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | Total |
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A3.3.1 Average Cost of LDZ Utilisation by Consumption Band

Table A3.3.1 shows that for the 0-73.2 MWh consumption band the cost is 14.71-p/peak day kWh, which is the total of each of the individual tier costs.

A4 Commodity Costs

Commodity costs are calculated using the same methodology as capacity costs but where capacity costs are based on peak day firm utilisation commodity costs are based on the annual utilisation for both firm and interruptible loads. Separate system, usage and connection probability tables are used to take into account all loads.

| Consumption | Pence /kWh | | | | | | | | | |
|-------------|------------|-----|-----------|-----|-----|-----|-----|-----|-----|-------|
| Band (MWh) | LTS | IPS | MPS | LP1 | LP2 | LP3 | LP4 | LP5 | LP6 | Total |
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A4.1.1 Average Cost of LDZ Utilisation by Consumption Band

A5 CSEP Methodology

The methodology for calculating LDZ transportation charges to CSEPs is the same as for standard LDZ charges with the exception that the connection probability data used to calculate the tier costs is based uniquely on CSEP data.

A6 Setting the Charging Function

To provide a workable basis for charging individual customers of differing sizes the average costs of utilising the LDZ network, as set out in table A4.1.1, are plotted. A function is fitted to the data points using regression analysis weighted by the consumption within each band. This function must then be scaled so that when applied to all supply points connected to the Transco network it will generate the desired target revenue.

A6.1 Function Form

At present the function is in the form of a single log with a straight-line element for the domestic (<73.2 MWh) load band. It is proposed that a power function with two fixed costs covering the domestic and the 73.2 - 732MWh bands should be adopted.

A6.2 Minimum Charge

Previous analysis of large loads connected to the LTS indicated that they use 69% of the LTS assets. This proportion has been used to set the minimum charge for loads connected to the LDZ as the charging function may imply charges that are not cost reflective for the largest connected loads. The minimum LDZ charge is calculated as 69% of the average LTS usage costs. The annual consumption, which when applied to the charging function results in this charge, is used as the lower bound for which the minimum charge applies.