GUIDELINES
FOR THE PREPARATION OF A
GAS CAPACITY STATEMENT

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EXECUTIVE SUMMARY

This document considers the requirements for producing a gas capacity statement ("the Statement") for Ireland's natural gas system[1], which the Commission for Energy Regulation ("the Commission") is required to produce by the Gas (Interim) (Regulation) Act 2002 ("the 2002 Act")[2].

These requirements take into consideration, where appropriate, comments and submissions received on a previous paper, 'Consultation on the Guidelines for the Preparation of a Gas Capacity Statement', published by the Commission on 2nd August last. Nine parties responded to the consultation and the Commission would like to thank those who participated in the process

The Statement will be an important element for the Commission in fulfilling its duties and functions[3]. In particular, the Statement will assist the Commission and the gas industry in identifying areas where network extension or development may be appropriate and thereby, ensuring the continuity and security of gas supply as well as ensuring the most economic and efficient development of the network.

This report has 3 main parts that consider:

- The content of the Statement including all the various elements of the natural gas system, system extensions and supply/demand forecasts that should be included in the scope of the Statement;
- the process for the preparation of the Statement including the steps and analysis that are to be taken in the development of the Statement; and
- the procurement of the Statement from the most appropriate Independent Consultant.

This document will now become the terms of reference for the preparation of the Statement by or on behalf of the Commission.

[1] Section 2 (1) of the 2002 Act defines the "natural gas system" as "the system of pipelines and liquefied natural gas and storage facilities, excluding upstream pipelines, used for the transmission, distribution, storage and supply of natural gas to, from or within the State". This definition is used throughout the Consultation Document.

[2] Section 19 of the 2002 Act refers to the requirement for the Commission to prepare an Annual Gas Capacity Statement

[3] In particular the Commission's functions as set out in Section 6 (c) (ii) (g) and (h) of the 2002 Act "to secure that there is sufficient capacity in the natural gas system to enable reasonable expectations of demand to be met; and to secure the continuity, security and quality of supplies of natural gas"

1. INTRODUCTION

Under the terms of the Gas (Interim) (Regulation) Act 2002 ("the 2002 Act")[4], the "Commission" for Energy Regulation ("the Commission") is required to prepare and publish an annual gas capacity statement (the "Statement"). This document will contain forecasts for the capacity, forecast flows and customer demand on each part of Ireland's natural gas system over the forthcoming 7-year period.

The Statement will include the current gas sources and the planned additional sources of gas including interconnectors and indigenous gas supplies such as from the Kinsale, Corrib and the Seven Heads gas fields. The Statement will identify the onshore infrastructure required to enable new sources of gas supply to be effectively utilised by existing and new demands in the natural gas system.

The Statement is generally expected to be based on information supplied to the Commission by natural gas undertakings, though it may also seek expert advice from other bodies and authorities as appropriate.

The purpose of the Statement is to assist the gas industry and the Commission in:

- Identifying areas where system development or extensions may be appropriate and thereby;
- Meeting reasonable expectations of demand and the continuity, security and quality of gas supply; and
- Ensuring the economic and efficient investment in new capacity.

This report is based on the consultation document circulated on 30 July 2002 and forms the basis of the guidelines for the preparation of a gas capacity statement for the natural gas system to supply natural gas to customers in Ireland. It is the intention to outline what the Statement should contain and to serve as the terms of reference for the preparation of the Statement by and on behalf of the Commission.

This report has 3 main parts:

- The section entitled "Content of the Statement" considers the various elements of the natural gas system, system extensions and supply/demand forecasts that should be included in the scope of the Statement.

- The section entitled "Process for Developing the Gas Capacity Statement" considers the steps and analysis that are to be undertaken in the development of the Statement.

- The procurement of the Statement is considered in section 4 wherein the preferred option for the Commission to prepare the Statement is outlined.

This report is the outcome of a previous consultation document[5] and comments received from parties are included as appropriate. This document will now become the terms of reference for the preparation of the Statement by or on behalf of the Commission.

[4] Section 19 of the 2002 Act refers to the requirement for the Commission to prepare an Annual Gas Capacity Statement

[5] "Consultation on the Guidelines for the Preparation of the Gas Capacity Statement" 30 July 2002

2. THE CONTENT OF THE STATEMENT

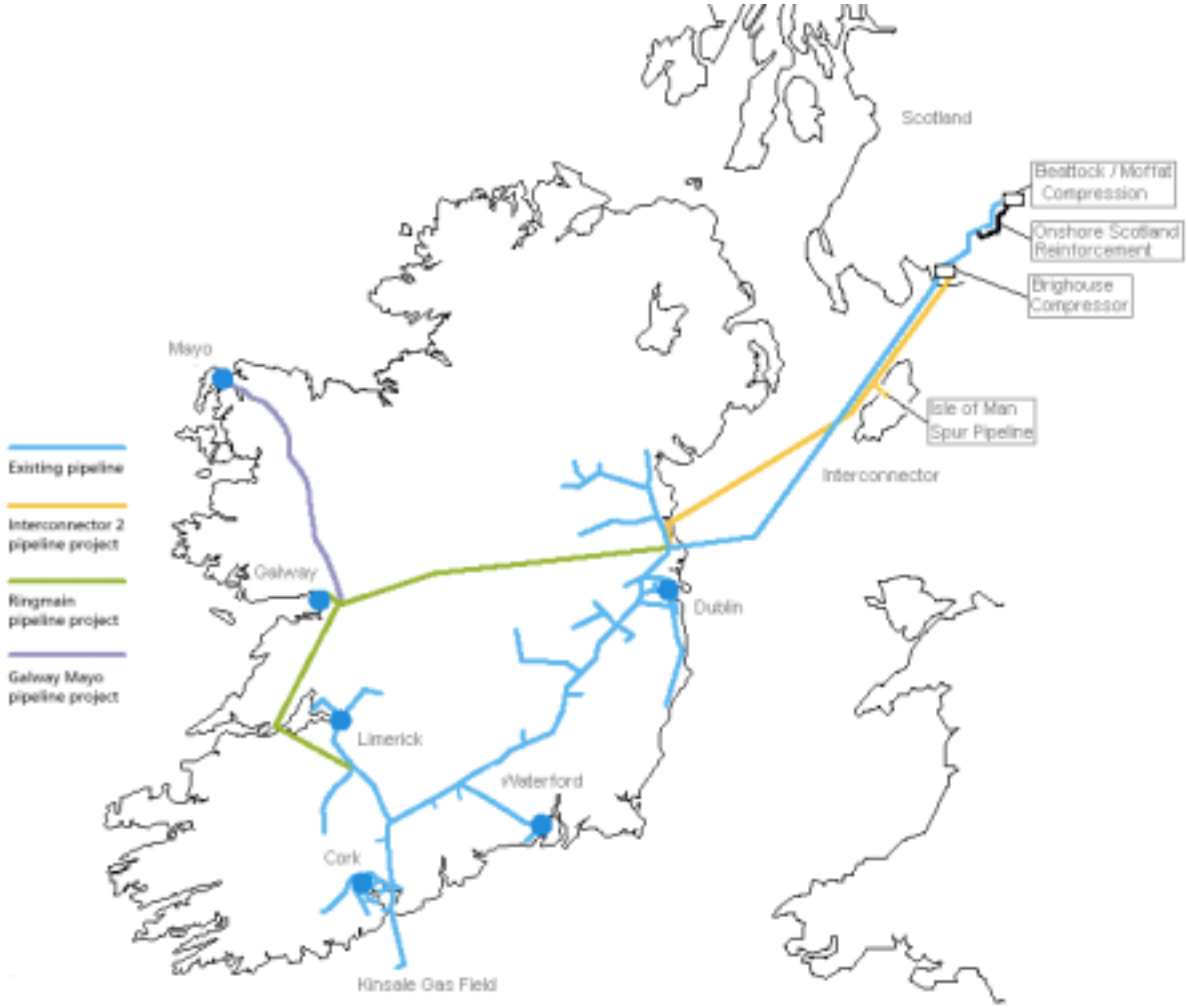
It is proposed that the content of the gas capacity statement should broadly consist of the following:

- The Natural Gas System (the Network) including transmission, distribution and storage facilities[6].
- Supply (anticipated future supply to the Network).
- Demand (anticipated annual and future peak demands on the Network).
- System Capacity (during peak demand and at other demand times).
- Opportunities for system development.

These elements will be discussed in turn below.

2.1 Ireland's Natural Gas System – Current Expansion

Growth in the demand for gas in Ireland has been the subject of a number of recent studies (see later references 1, 2 and 3). The conclusions and recommendations of those studies identified a need to increase the physical capacity of the network. In response to the projected demand growth, Bord Gais Éireann (BGÉ), is undertaking major network expansion. Figure 1 shows the expansion underway on the transmission system in Ireland.



[6] Section 2 (1) of the 2002 Act defines the "natural gas system" as "the system of pipelines and liquefied natural gas and storage facilities, excluding upstream pipelines, used for the transmission, distribution, storage and supply of natural gas to, from or within the State". This definition is used throughout the Consultation Document.

Figure 1: BGÉ Gas Transmission System showing Existing and Current Reinforcements

There are three major pipeline reinforcement projects presently in progress and which have been granted Section 39A Consents under the Gas Act, 1976 (as amended):

- The 2nd sub-sea interconnector between Brighouse and Dublin.
- The 'Ringmain Project' connecting Dublin and Galway with the existing Limerick to Cork transmission pipeline.
- The 'Galway – Mayo' pipeline.

The physical capacity of the natural gas system will increase as each of these projects is brought into operational use. From this transmission system, gas is supplied either directly to the largest loads (such as power stations), or into lower pressure tiers of the gas infrastructure.

2.1.1 Scope of Capacity Statement

The Statement is required to represent 'each part of the natural gas system'. The level of detail appropriate, which is proposed by the Commission, is to include the high-pressure transmission network tier including the demand on each primary offtake from the transmission system. There are currently some 70 such off-take points, which includes the primary input points to the Distribution Network. It is also considered that the capacity Statement will include the validation of a sample of distribution networks to confirm the demand exemptions, design criteria and capacity availability of these networks.

2.2 System Supply

The Irish gas system is currently undergoing significant reinforcement that is designed to accommodate considerable changes in future sources supplying the network. Significant gas supply changes include likely increases in supply from the UK via the second interconnector, and from new indigenous offshore fields at Corrib and Seven Heads, while the Kinsale fields continue to produce albeit they are in decline. Additionally, there is potential for the development of storage in the Kinsale area.

Forecasts of all supply and storage, as well as imports and exports will be incorporated in the Statement. The existing and intending Producers/Storage Operators and Suppliers/Shippers will be expected to provide this information as appropriate. The Statement will consider the impact of any predicted imbalances in the sources of gas supply (e.g. if planned supplies from the UK National Balancing Point cannot be delivered in full).

2.3 System Demand

The demand on the natural gas system is comprised of several sectors, broadly domestic, industrial, commercial and power generation. Large loads and those used to generate electricity may now be supplied under third party access[7].

[7] Eligible customers entitled to require third party access are those customers using more than 2 million standard cubic meters (mscm) a year and those using gas for power generation irrespective of the size of load

Gas demand in each sector is subject to demographic change and the relative price of competitive fuels, and has been described in a forecasting study undertaken by the Economic and Social Research Institute (ESRI).

It is proposed that the gas capacity statement be consistent with relevant economic forecasts as well as those aspects of gas demand forecast data that may be contained in the Electricity Forecast Statement.[8]

The gas demand for loads on the transmission system may be represented in two ways, each of which is important. One is the peak requirement for gas over any given day and the other is the annual demand. The relationship between these two values is often expressed as a load factor, described in more detail in Section 4.2.

Gas demand on distribution systems is characterised by loads that may apply during shorter periods, because of the lack of storage within low-pressure pipe systems.

Typically these periods are the peak 6 minutes for distribution networks.

2.3.1 Forecast Demand Information Provided by Natural Gas Undertakings

It is appropriate that those undertakings involved in the shipping, supply, storage and transport of gas in Ireland be invited to provide details of their forecast requirements for gas. This may include a range of demand forecasts (typically setting out high and low cases) to allow for forecast uncertainty.

This information is required to include both the peak day and annual demand value, together with geographical location. The Statement will include the audit and validation of the data supplied against historical patterns of weather and gas demand.

However this information must be aggregated and confirmed to represent robust, realistic and credible estimates for gas demand over the forecast period of 7 years. In particular the possibility of prospective gas loads being included more than once must be considered and taken into account.

The Commission may wish to seek information on a more aggregated basis from national bodies such as the ESRI or other reputable institutes and bodies to assist in the assessment of estimates of gas demand by gas undertakings.

In the past ESRI[9] data has been used for forecasting capacity requirements. The Commission will take into account ERSI data as well as data to be provided by Gas Suppliers/Shippers.

2.3.1.1 Interruptible and firm loads

Some suppliers/customers may have negotiated an interruptible transportation agreement with the Transporter. In these circumstances, for a number of days each year, the load may be cut off with an agreed notice period and the customer must make other arrangements. These interruptible loads are assumed to be not supplied at periods of peak gas demand and are therefore not included in the peak day analysis. Interruptible gas loads need to be identified because they contribute

[8] ESB National Grid Forecast Statement 2001/2 – 2007/8.

[9] ESRI Working Paper 136: Energy Demand to 2015.

to the annual demand and overall pipeline utilisation, and will be included in any "summer" demand scenarios.

2.3.1.2 Weather sensitivity of load

The demand of many gas loads is related to the weather. In the case of large third party access loads, the peak supply volumes will be contractually defined.

In the case of smaller eligible loads, the shippers are unlikely to know the weather relationship of their customers' demand. In such cases, it will be necessary to rely on the historical information held by BGÉ or (for future Statements) any other transporter.

The normal practice is to relate the demand over a period of a single day, to a characteristic weather factor that applies to that day. The weather factor is often a combination of the average daily temperature, and day of the year. Additional factors may then be applied to scale between weekdays, weekends and holidays. The weather data used may be selected to reflect local conditions, or averaged over a larger geographical area. A description of the methods and assumptions used will be included in the Statement.

Domestic and other tariff customers will combine with industrial and commercial loads to create localised demands at specific points on the transmission system.

In this case the need is to determine the peak demand on a day of agreed severe weather (e.g. most severe day statistically likely in a 50 year period which is termed a 1 in 50), at an appropriate level of detail on the pipeline network.

The information required to do this is likely to be held by BGÉ.

2.4 System Capacity

The capacity of a pipeline system to supply is related to the duration over which the gas demand is required. High-pressure gas pipelines may, over a relatively short time period, supply a higher flow of gas than could be continuously supplied. This is achieved by temporarily reducing the line pressure to provide more flow.

The demand for gas varies within the day and the normal supply criteria for the peak capacity of a pipeline is that the pressure may decay within the day, but must recover at the end of the 24 hour cycle. This within day pattern of demand and pressure change is termed 'diurnal'. A pipeline capacity is considered to be approached when the pressure recovery cannot be attained at the end of the gas day.

Because of the transient nature of gas flow, and the complexity of the networks with varying pressure and compression it is necessary to apply mathematical models to the process. These models allow the pressures and flows to be determined over the time period of interest. These issues are discussed in more detail later.

2.5 Opportunities for System Development

The Statement should provide sufficient capacity information to assist the producers, storage operators, system users and developers in their future investment decisions, in particular to ensure there is adequate onshore infrastructure to enable new indigenous supplies and other supplies to be utilised in the Irish natural gas system.

3. PROCESS FOR DEVELOPING A GAS CAPACITY STATEMENT

The development of the capacity statement is likely to involve the following steps:

- Agree time periods to be used. The gas year runs from the 1 October to 30 September and it is proposed that the Gas Capacity Statement be developed for each gas year within the seven-year period. The years 2002/2003 through to 2008/2009 inclusive are therefore proposed for the first Statement.

- Agree the level of Network pressure tiers to be used in the models. In this case the supply points to the transmission system and the offtake points from the transmission system and the interconnectors are proposed.

- Incorporate the authorised extensions to the network – by consultation with gas undertakings and the Commission. Authorised extensions will include those with approved consents and those extensions that the Minister/Commission have given an indication of an intention to authorise via a competitive process.

- Establish severe weather criteria to be applied in order to assess peak supply capacity of the system.

- Determine from gas undertakings their anticipated customer loads, types of load, and location.

- Determine (assisted by information supplied by gas undertakings) demand profiles for agreed weather scenarios for the exit points from the system for each of the time periods under consideration. These profiles shall exclude interruptible loads.

- Determine likely scenarios for gas injections into the Network.

- Determine the pipeline model detail appropriate for each time case.

- Determine the system interface limits, operating margins and security of supply criteria to be applied.

- Apply demand load scenarios to pipeline models.

- Analyse results.

Aspects of these stages are discussed in more detail below:

3.1 System planning

This section discusses the key aspects to be addressed during system capacity planning.

3.1.1 Security of Supply and Design Basis

Gas systems are planned to satisfy a standard for security of supply. The criterion is described as the projected 'firm' demand for gas resulting from a particular ambient temperature. It is this criterion that in effect 'sizes' the physical capacity of the network. To avoid unnecessary expansion in later years it is appropriate to consider future load growth within a reasonable planning horizon.

The BGÉ [10] design criteria is based on providing the capacity for the projected firm peak day demand, projected to result during the coldest day of a 1 in 50 winter (i.e. the weather on a 1 in 50 peak day), which is similar to the overall design of the UK combined storage and pipeline Network. Prudent system operators would consider firm market demand growth projections within the planning horizon. Currently, UK gas and electricity utilities use planning horizons of 10 and 7 years respectfully. The 2002 Act requires the gas capacity statement to consider a 7 year period, which is the same as for Ireland's electricity sector.

3.1.1.1 Flow Considerations

There may be a variety of ways in which a system may be configured to supply natural gas; the optimum means being identified through flow modelling studies, which would take into consideration the following requirements.

3.1.1.2 Pressure Considerations

Coincidental with peak demand, the entry point inlet pressures are likely to be lower than usual. For design purposes, capacity sizing requires identification of the minimum guaranteed entry point pressure conditions. Exit point pressure conditions are also critical for planning purposes.

3.1.1.3 Storage Considerations

There should be sufficient capacity in the transmission system to cater for the release of additional volumes to satisfy the diurnal variations between the supply and demand profiles over a gas day. Because there are no physical storage facilities on the BGÉ network at present to provide gas directly into seasonally sensitive firm gas markets, all firm peak demand has to be supplied from pipeline capacity for the time However, current arrangements between BGÉ Energy Supply and Marathon allows some profiling of the gas and this will be taken into account in the Statement. Consideration will be given to storage if storage facilities are anticipated to be available within the timeframe of the capacity statement

[10] Bord Gais Eireann Transmission Business Unit – Nat Gas Supply & Demand Projections Jan 2001

3.1.1.4 Operating Margin

A small capacity margin is usually added during the sizing process to cater for the possibility of a forecasting error or equipment malfunction, such as a compressor trip. This may be a percentage increase on peak flow or a specific volume determined through simulation.

3.1.1.5 Diversity

Even under the peak demand situation there will be times, due to the intermittent nature of the connected loads, when the instantaneous demand is slightly less than the theoretical peak. This is termed diversity and assumes the peak supply to any group of customers will be lower than the sum of the individual peak demands of all the customers.

3.1.2 Seasonal Variation

Clearly, during warmer ambient conditions, the demand from temperature sensitive loads would be less and entry point pressures higher and therefore the network could have increased capacity under those conditions.

Figure 2 shows a typical annual gas demand profile[11]. The highest demand occurs on only a few cold winter days where transportation of firm gas demand dominates. The system design criteria sizes physical pipeline capacity to meet the peak day demand based on a severe weather criteria.

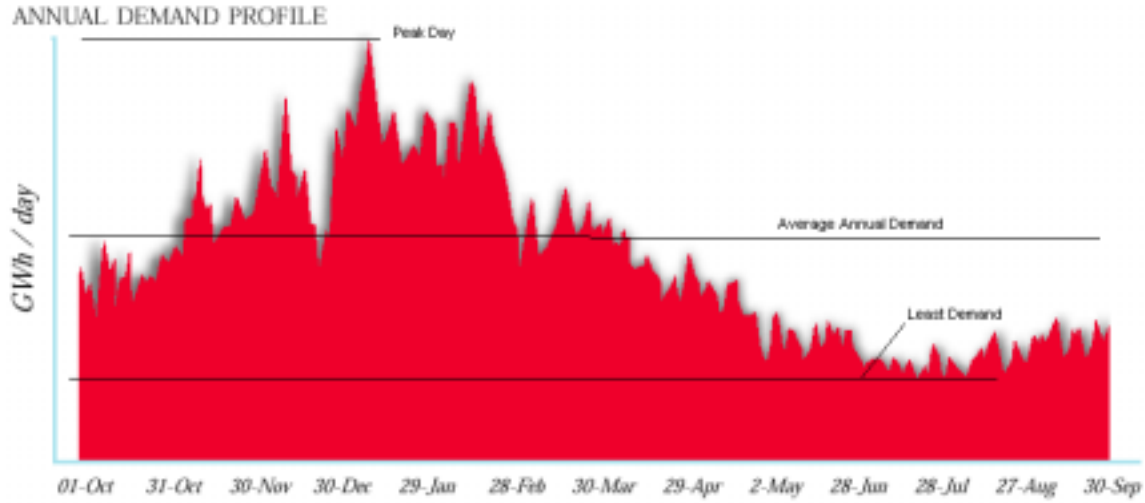


Figure 2: Typical Annual Demand Profile

A measure of the utilisation of a pipeline can be expressed in terms of its load factor where;

$$\text{Load Factor (\%)} = \frac{AnnualDemand}{PeakDayDemand x 365}$$

[11] Bord Gais Eireann – 2025 Public Document – Section on Design Basis, demand curve

3.1.3 Variation in Demand and Supply Profiles

The Irish gas demand varies on a daily and seasonal basis. However, the daily and seasonal supply into the network tends to be injected at a steady rate with only marginal variation during the day.

This steady supply rate is a technical requirement normally adopted to optimise production from producers' plant and at Transco's supply point at Moffat, to protect their transmission system from excessive load variation. Therefore, for a given days' gas demand forecast, the hourly injection rate into the network would be assumed to be at a $1/24^{th}$ rate for the demand to be transported for the day. [These requirements would be reflected in the Network Exit Agreement between Transco and BGÉ and in BGÉ's contractual agreements with their Shippers]. However, the option of profiling at major Entry Points will be considered in the Statement.

The conflict between the diurnal demand variation and steady supply into the network is catered for by pressure cycling in the transmission system. The release of volume to match demand, in excess to that being supplied, is achieved by flexing the transmission pressure between the supply and demand points and is referred to as linepack release. The 'flexibility' volume required for diurnal management would be considered at the pipeline design stage.

3.2 Determining Capacity

Whilst it is simple enough to calculate the flow capacity of a length of pipe under steady state conditions, the problem of dealing with multiple entry and exit points, compression and a period of varying demand in a network of looped pipes where flow could occur in either direction, requires the problem to be simulated. To provide coherent capacity information within the BGÉ network requires system modelling of a number of scenarios. This approach would provide information to determine both network capacity and pipeline load factor.

3.2.1 Modelling Tools

BGÉ have a proprietary package of modelling tools that enables BGÉ to undertake detailed transient modelling on their Network.

The fact that BGÉ retains such an extensive modelling capability as a potential route for the provision of capacity information has been taken into account by the Commission in its decision as to the most appropriate route for preparing the Statement

3.2.1.1 Modelling Overview

Completion of the 2^{nd} interconnector, the 'ringmain' project and the Mayo – Galway pipeline are envisaged within the timeframe of the capacity statement and these pipelines will provide a significant addition to network capacity.

Models representative of the transmission network, with all entry and exit points, are likely to provide a significant level of capacity information. It is possible that additional models of lower tier systems may be required to establish whether capacity constraint exists within distribution networks.

As a minimum, the transmission models should comprise the following physical pipeline details:

- all entry points, i.e. Moffat, Inch and Mayo;
- all transmission pipelines;
- all compression plant;
- all operational 1st tier volumetric offtakes; and
- all operational 1st tier pressure control offtakes including those for power generation.

The base transmission model should be representative of the network as of October 2002. It is suggested that 6 further models be considered, these representing the network for each gas year between October 2003 and October 2008, which is the period of the first Statement. Each subsequent model would be a modification of the base model.

The physical and geographical details will need to be obtained from BGÉ.

The validation of a sample of the BGÉ Distribution Networks shall seek to confirm the demand assumptions, design criteria and capacity availability in the distribution networks.

3.2.1.2 Scenario Modelling

It is suggested that the capacity and utilisation of the network be examined against selected supply and demand scenarios. High and low growth demand forecasts will be modelled to accommodate forecasting uncertainty. The Statement will include forecasts and assumptions used in the development of the corresponding [Electricity Demand Statement].

Three weather scenarios are considered appropriate, as representing the demand and supply match for a 'gas day'. These scenarios would be:

- No.1 1 in 50 peak day;
- No.2 Average Winter day; and
- No.3 Average Summer day.

In addition, the Statement will include a scenario of a continuous period of the most severe weather experienced in the last 50 years. This will test the robustness of the Pipeline System over a prolonged severe weather event.

The model would be set up with 'initiating' data, which sets the starting node pressures, for each scenario. The 'scenario' flow profiles, representative of the gas day, would be applied to the entry and exit nodes.

3.2.1.3 Entry Points

Entry point supply profiles, for each scenario, would be typically 'flat' to represent 1/24th rates for the simulation period. (Compression at Beattock is likely to be in flow control at a 1/24th rate to match the offtake contractual rate). Similarly entry points at Inch and Mayo would tend to be 'flattish' profiles as dictated by producers steady state production operation. Details for likely supply scenarios will be required from the shippers and producers. This may include for any supply scenarios that would be provided by any storage facility that may be commissioned in the period of the Statement.

3.2.1.4 Exit Points

Demand profiles, for each scenario, would need to be representative of the particular exit point.

Power station demands may be base load and therefore 'flattish', others could be '2-shift operation or load following.

Other pressure control exit points could have significant domestic loads connected, in which case the classic diurnal profile would be appropriate.

Large volumetric offtakes would tend to have 'flat' $1/24^{th}$ rates but may include contractual variation.

3.2.2 Model Output

The transient pipeline model determines the changing pressure, over a 24-hour duration, within the network at various node points for the particular scenarios.
A number of model runs would be considered for each scenario to develop a 'picture' of how the network pressures vary and to show how compression is being utilised. This kind of 'what if' approach can be used to develop capacity and pipeline utilisation information for each part of the network.

All confidential information received from market participants will be suitably protected.

3.2.2.1 Constraint Modelling

Pipeline capacity can be affected by certain system constraints. Examples include a reduction in flow at a supply point due to a production problem or a compressor trip. The model could be used to explore the 'flow margin' within the system to ride through these kinds of constraint problems.

3.2.3 Data Required

The accuracy of a pipeline model is dependent upon the quality of data used to build the various elements.

It would be essential for BGÉ to provide a significant part of the information identified below. The accuracy of the simulation depends upon access to the following basic requirements:

- The physical sizes of pipelines;
  - Pipe length, internal diameter, coating details
- Compressor details;
  - Location and number of units
  - Envelopes of head vs. flow with speed and power lines
  - Operational methods, i.e. parallel or series running
  - Suction, discharge or flow control
- Details of system pressures;
  - Maximum design and guaranteed minimum system inlet pressures
  - Guaranteed minimum suction pressure to compressors
  - Guaranteed minimum inlet pressures to all offtakes
- Details of likely gas supply scenarios

- Details of demand profiles typical of scenarios;
  - At all large industrial loads i.e. gas fired power stations
  - At all AGI's
- Details of the location of system offtakes;
  - Details of downstream pressure set points for pressure offtakes
- Details of the phasing of future system enhancement plans (Oct 2002 to Oct 2008)
- Details of gas properties
- Details of gas temperature

4. PREFERRED OPTION FOR PROCURING THE GAS CAPACITY STATEMENT

The preferred Option for procuring the Statement is outlined below. Because of the technical requirements posed by this, there is little doubt that specialists having expertise in gas network modelling would be likely candidates for developing the information required to define pipeline capacity and utilisation.

The use of modelling is considered the most efficient means of developing information on system capacity and utilisation. Clearly, the models would play a key role for this investigation and any subsequent related issues arising in the future.

4.1 Preferred – Use of an Independent Consultant to Utilise BGÉ Models

The Commission will use an independent consultant to produce the Statement by using BGÉ's Network models, but applying assumptions and supply/demand scenarios set by the consultant after agreement with the Commission. It is clear that BGÉ will need to play a central role in assisting with the important task of providing system information. BGÉ have already developed a large suite of network models. In addition, they will also have extensive knowledge of supply and demand information.

Clearly, there is merit in considering utilising BGÉ's resources in this area on the basis that significant savings in time, effort and expense could be achieved if all parties in the gas industry were prepared to accept BGÉ's close involvement.

The issue of independence is important and is achieved by the Independent consultant having authority to oversee the BGÉ modelling team. It is envisaged that the independent consultant would control the scope and assumptions of the modelling and scenarios and independently verify the supply and demand profiles to be examined. BGÉ would be responsible for producing the output data from their models and passing this back to the independent consultant for processing. The independent consultant would be responsible for verification and reporting the capacity statement to the Commission. The realistic timescales for this option is to produce a draft of the first Statement for consultation by [January 2003], with publication of the final first Statement by [March 2003]

5. NEXT STEPS

The Commission will shortly invite tenders from parties to develop the Statement. This document will form the basis of the tender documents.