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THE POWER OF ACTION

Determination of the Technical Capacity of the National Transmission System

Compliance with Regulation EC 715/2009

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Background

In order to be compliant with EU Regulation EC 715/2009 of 13 July 2009 on conditions for access to the natural gas transmission networks:

"Transmission System Operators shall publish a detailed and comprehensive description of the methodology and process, including information on the parameters employed and the key assumptions, used to calculate the technical capacity"[1].

"Technical capacity" is defined[2] as "the maximum firm capacity that the Transmission System Operator (TSO) can offer to users, taking account of system integrity and the operational requirements of the network" and must be published "on a numerical basis for all relevant points including entry and exit points"[3].

The National Transmission System (NTS) is a complex gas network with many interactions, hence the technical capacity needs to be defined in respect of statutory obligations and customer requirements as well as physical limitations.

Baselines

In the UK, the establishment of baselines is a Regulator led process which involves the Regulator, the Gas and Electricity Markets Authority ("the Authority"), setting defined quantities of capacity at entry and exit points, to and from, the NTS. Through the Licence[4] the Authority have placed obligations on National Grid Gas (NTS) ("National Grid") to offer this baseline capacity for sale through a number of entry capacity auctions and exit capacity application processes.

Baseline capacity satisfies the above definition of technical capacity in that it:

- can be, and is, offered to users as firm capacity,
- is determined after taking account of system integrity and the operational requirements of the network and
- is determined on a numerical basis for individual, i.e. relevant, points on the network.

Baselines were not set in isolation, but were determined as part of the wider Transmission Price Control Review (TPCR) package negotiated with the Authority. The most recent being TPCR4, covering the period 2007 to 2012. Industry consultations on baselines are incorporated within the broader Licence development covering gas transportation in its entirety, including the capacity regime.

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[1] Commission Decision of 10 November 2010 amending Chapter 3 of Annex I to Regulation (EC) 715/2009, paragraph 3.1.2.(m).
[2] Article 2.
[3] Article 18 paragraph 3.
[4] National Grid Gas plc Gas Transporter Licence in respect of the NTS.

The level of baseline capacity is based on statutory and commercial obligations supported by analysis of the network and its technical limits, i.e. they are based on the operational requirements of the system and its integrity. Once set, the Authority will fix baselines over the relevant price control review period, which has historically been five years. There is scope for varying baselines, but this is subject to defined rules and is subject to Authority scrutiny and approval. In accordance with the Licence, National Grid is obliged to make available to Users the baseline quantity.

Hence, as baselines equate to the technical capacity of the NTS, the methodology used to determine baseline quantities is the same as that used to determine technical capacity. This methodology is described in detail below.

Determination of Technical Capacity at Entry Points

It should be noted that the methodology for determining baselines has evolved between different price control periods. The summary below describes the approach taken during the previous price control review (TPCR4)[5].

The key objective in determining Entry Capacity baselines is to set capacity levels that adequately reflect the physical capability of the network at each individual entry point and for the network in aggregate, whilst taking into account changing gas flow patterns on the network.

The following key points were considered in determining baselines and are described in more detail below:

- The Base network;
- Supply and demand assumptions;
- Balancing the network;
- Determining entry point capability;
- Zonal and nodal interactions.

The Base Network

As mentioned above, the NTS is a complex gas transmission system with many interactions. In order to support the analysis required for setting baselines, the use of network analysis software (Graphical Falcon) was required. Graphical Falcon is a detailed mathematical model of the NTS which was used to understand the likely flows and pressures on the system under a given set of supply and demand assumptions.

The physical network model that was used to support analysis for the prevailing Gas Transportation Ten Year Statement (see below) was used for the network analysis undertaken to help determine baseline quantities. This was referred to as the 'base network' and comprised of existing infrastructure including planned investment.

[5] The detailed methodology of how baselines were set for TPCR4 can be found on the Authority website:
http://www.ofgem.gov.uk/Networks/Trans/Archive/TPCR4/ConsultationDecisionsResponses/Pages/ConsultationDecisionsResponses.aspx

Supply and Demand Assumptions

Annually, National Grid runs the Transporting Britain's Energy (TBE) consultation which sets out the latest projections for gas supply and demand over a ten year horizon and is based on information collected from many gas industry participants and the outcome of the long term entry capacity auctions. This information is then incorporated into the Gas Transportation Ten Year Statement (10YS) which is published at the end of National Grid's annual planning process and explains the latest volume forecasts, system reinforcement projects and investment plans.

As published within the 10YS, one of the key drivers for investment in gas transportation infrastructure is the forecast level of 1 in 20 peak day demand[6], therefore NTS exit points were set to these flow levels.

In order to manage the uncertainty in future supply patterns, National Grid developed a range of supply scenarios in order to determine relevant network reinforcement and investment projects. These were described in the prevailing[6] 10YS and were referred to as Transit UK, Global LNG and Auctions+. Each scenario was considered and the associated flows were assigned to each entry point on the NTS.

Balancing the Base Network

As described above, the base network model is a representation of the existing and planned infrastructure on the gas transmission system. In order to use the model, entry and exit gas flows were required to be loaded into the model.

The supply and demand scenarios described above were applied to each entry and exit point on the network model. A key assumption in performing network analysis requires that aggregate supplies entering onto the system must match aggregate demand being taken off the system.

Prior to balancing the network, the aggregate level of forecast supply (for each supply scenario) across entry points was greater than the 1 in 20 peak day demand. The supplies needed to be scaled down to match the peak day demand in order to balance the network. A 'merit order' approach was adopted which involved turning down supplies at storage sites. This was National Grid's standard approach for network modelling. The balanced base network represented the starting point from which to determine network capability.

Determining Entry Point Capability

Network capability at each entry point was defined as the maximum capacity that could be released at that entry point on a 1 in 20 peak day demand given the base network infrastructure and without triggering the need for network reinforcement.

The following methodology considered each entry point in isolation. In order to determine the maximum nodal capability, gas flows entering at the chosen entry point were increased beyond the initial supply scenario forecast level (base flows) until a

[6] 2005 Gas Transportation Ten Year Statement

network constraint was identified, thereby indicating the threshold of maximum capability.

To keep the network in balance, a 'least helpful supply substitution' methodology was applied. Under this approach, as the supply at a particular entry point was increased to determine its maximum capability, supplies across other entry points were turned down to keep the network in balance. Selection of the entry points to turn down were those identified as providing the point of least interaction with the entry point in question whilst assuming flows at nearby entry points were relatively high.

The difference between the maximum capability and the base flow was referred to as the "free increment" (i.e., the additional capacity that could be released at each entry point when considered in isolation, over and above the base flow). It should be noted that it is not possible to accommodate all of the entry point free increments simultaneously.

Zonal and Nodal Interactions

In addition to local (nodal) constraints there may be additional regional or 'zonal' constraints, i.e. the zonal free increment is less than the aggregate of the nodal free increments in that zone. In order to take these into account, the free increments were then considered on a zonal, rather than nodal basis. For example, if there were three entry points in a given zone with free increments of 50 GWh/d, 100 GWh/d and 20 GWh/d, the 100 GWh/d free increment would serve as a proxy for the maximum zonal free increment.

The maximum zonal free increment was then divided between each node in the zone in such a way that each node received at least the amount of capacity which had already been sold by National Grid in respect of that zone. Any remaining zonal free increment was then allocated in proportion to a measure of the 'size' of the entry point in question. The size of the entry point was proxied by the peak terminal supply associated with that entry point in the prevailing 10YS.

The arithmetic mean of the results from all the supply scenarios modelled would then be used to calculate the baseline capacity.

Determination of Technical Capacity at Exit Points

Exit capacity baselines are determined using a 'Practical Maximum Physical Capacity' methodology. The overriding principle behind this approach is that exit capacity baselines are calculated consistent with the maximum quantity of capacity available at each node, given a set of plausible scenarios for flows elsewhere on the network.

This approach therefore takes into account the interaction between nodes. In essence these baselines will be above the 1 in 20 firm forecasts upon which the system is designed.

The methodology for determining baselines is described below:

1. The starting point is to establish a balanced demand and supply position based on 1 in 20 demand;
2. The NTS must be able to simultaneously meet the combined baselines at each offtake without the need for exit investment or significant buyback
3. Increases in demand, to determine the maximum exit capability at an exit point, are matched with increases in supply based on forecast assumptions of additional entry capacity
4. Modelling continues, by increasing exit flow, until investment is required for 'exit' purposes

This process identifies the maximum capacity by exit point which has been used to equate to baselines, and hence technical capacity.