
Northern Ireland Gas Transmission System



PRESSURE REPORT

December 2007

This report summarises the 2007 Northern Ireland gas transmission pressure study.

This study is a joint collaboration between the three Transmission Operators licensed by the Northern Ireland Authority for Utility Regulation, NIAUR.



Executive Summary

The three transmission operators within Northern Ireland have jointly prepared this report with a view to providing an understanding of the future potential of the NI network. The report has been carried out with updated demands as provided by the Shippers & provides a summary of the analysis carried out & results obtained.

As well as examining a “business as usual “base case scenario, the 2007 pressure study has also taken the following possible future events into consideration.

- A new CCGT at Kilroot
- A potential delay to Corrib. The base case in this study assumes Corrib online in Q4 2009.
- A new CCGT off the South North Pipeline
- An increase demand at Ballylumford.
- A storage facility in Northern Ireland
- Shannon LNG

The analysis is focused solely on engineering issues and it does not address matters of a commercial nature. The purpose of this study is to assist in providing an understanding of the issues facing the Northern Ireland gas market.

Conclusions

- 1 The existing NI Transmission network has sufficient capacity to cater for significant load growth. No reinforcement is anticipated over the period of the study (2007-2013).
 - 2 If Corrib is delayed by 1 year, then under peak winter conditions, operating pressures may be lower than previously experienced.
 - 3 Changes to the network’s current mode of operation would improve prevailing pressures in the system. For example :
 - Operating Twynholm in pressure control.
 - The removal of flow control restrictions at Carrickfergus.
 - 4 In certain circumstances, the SNIP pipeline system has the potential to flow above existing contractual limits.
 - 5 In the later years of the study, analysis indicates that a rebalancing of the flows between SNIP & the South-North pipeline, may improve network pressures – the commercial implication of this would require further review of the options.
 - 6 Results of the performance testing of the compressors and pipelines between Scotland and Ireland will provide a more precise limit on the capacity of this system.
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1 INTRODUCTION

This report provides information on the predicted pressures in the gas supply system to Northern Ireland for the years 2007/08 to 2013/14 inclusive based on capacity figures provided by Shippers. These seven years are consistent with the time period used to produce the 2007 Gas Capacity Statement for the Republic of Ireland.

The model used was one consisting of all of the pipelines which supply the whole of Ireland and was similar to those used to produce the 2007 Gas Capacity Statement for the Republic of Ireland but with the addition of the pipelines between Twynholm and Coolkeeragh including the South - North pipeline.

The study was carried out in the with the 8.08mscmd contractual limit applied to flows along the SNIP system.

The SNIP/NWP model has been calibrated by independent consultants and this calibration showed good agreement with actual pressures recorded on the system.

2 MODEL DETAILS

2.1 Demand

The base case demands supplied by the SNIP system, the North - West Pipeline and the South - North Pipeline are outlined in Table 1.

Year	2006 NI Pressure Report Demand Estimates		2007 NI Pressure Report Demand Estimates	
	GWh/day	Mscmd ¹	GWh/day	Mscmd ⁽¹⁾
2007/08	82.71	7.44	83.51	7.55
2008/09	85.38	7.68	84.85	7.67
2009/10	87.31	7.86	86.96	7.86
2010/11	87.98	7.92	89.18	8.06
2011/12	90.62	8.16	91.37	8.26
2012/13	91.84	8.27	93.18	8.42
2013/14	-	-	95.19	8.61

Table 1 ~ Base Case Demand

The comparison shows that the total forecast level of demand predicted this year is higher than that predicted last year. A review of the level of the demands was made in August 2007 and these include the forecasts made by the shippers.

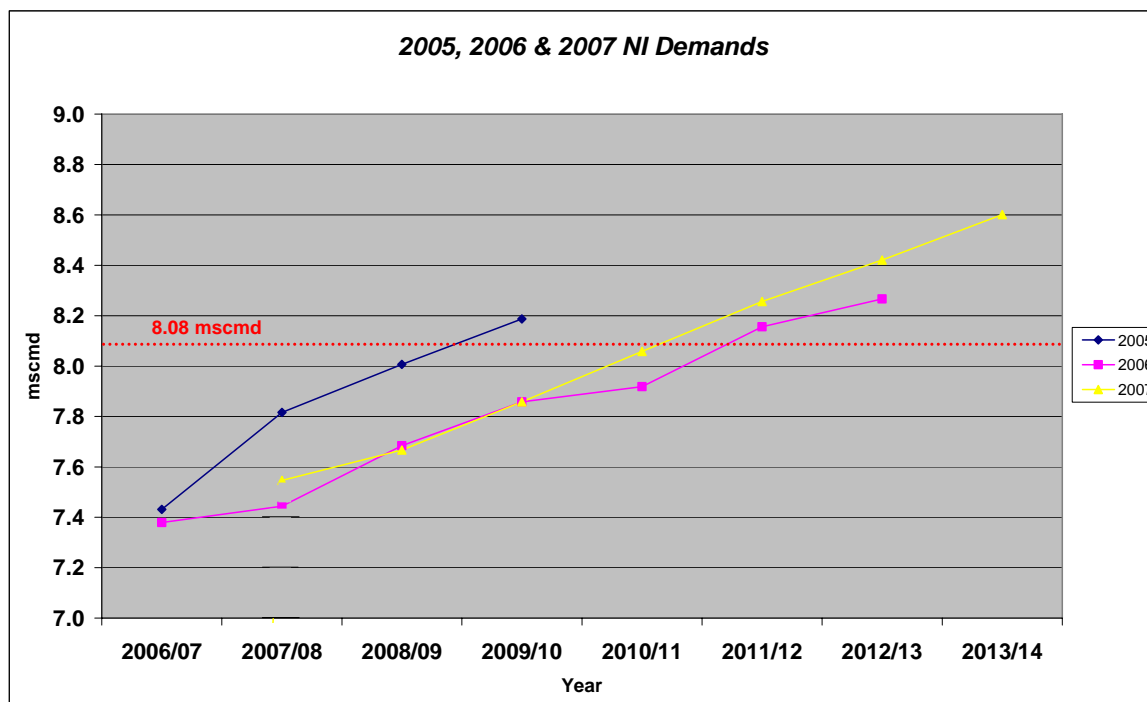
For demands in the Republic of Ireland the values used are based on the central demand case used to produce the 2007 Gas Capacity Statement for the Republic of Ireland; the demands are based on information derived from a number of sources including shippers.

Footnote 1 The actual flow rate will vary according to the calorific value of the gas delivered which is currently predicted to be of the order of 40 MJ/m³ at Beattock and the volumes given in the table below assume that value for the CV. In the 2006 report the average value was 40.01 MJ/m³; this value has been reduced slightly to 39.84 MJ/m³

This statement is available from the CER website at <http://www.cer.ie/CERDocs/cer06150.pdf>.

It should be noted that the NI demands in the 2007 Gas Capacity Statement for the Republic of Ireland are not the same as those used in the production of the pressure report as this report was produced prior to the latest demand forecast made for Northern Ireland.

A graph of the forecast peak demands for 2005, 2006 and 2007 is shown below; this shows that the changes from last year's forecast are quite minor compared to the 2005 to 2006 forecast changes.



2.2 Supply

The peak day supplies into the system are tabulated below for the base case. Gas is assumed to be delivered from Corrib in 2009/10 which represents a delay of one year from the delivery date assumed in the 2006 Study Base Case.

Year	Peak Day Supply Flows (mscmd)		
	Inch ²	Moffat ³	Corrib
2007/08	3.83	27.32	0
2008/09	3.53	28.42	0
2009/10	3.36	20.46	9.98
2010/11	3.22	22.82	9.98
2011/12	3.13	24.72	8.87
2012/13	3.05	26.98	6.88
2013/14	3.00	29.04	5.32

² Inch flow excludes Midleton fuel gas and includes storage

³ Moffat flow excludes Beattock and Brighthouse Bay fuel gas

These clearly show that the amount of gas delivered to Ireland through Moffat increases until the Corrib field delivers gas to the ROI transmission system.

There are some sensitivity analysis scenarios where the effect of a delay in the delivery of Corrib gas has been determined and the supplies under those conditions are detailed in the relevant sections. The effect of the addition of an LNG terminal on the Shannon and salt cavity storage in Northern Ireland has also been investigated.

It should be noted that Beattock was designed for a flow of 26mscmd. There is a high level of confidence that a flow of 31mscmd can be accommodated and performance testing is currently in progress to determine the precise limit.

3 RESULTS OF NETWORK MODELLING

3.1 Scenarios

In the base case the analysis was carried out at the peak day demand level for the period 2007/08 to 2013/14 inclusive and the results for this are included in the main body of the report.

A number of sensitivity cases were included to test the robustness of the system to potential changes in the base assumptions that could occur over this period. The results of the analysis are included in the Appendices.

These cases are as follows:-

Sensitivity 1: The base case scenario but with Corrib delayed by one year to commence supply in 2010/11.

Sensitivity 2: A new 400MW CCGT station located at Kilroot in 2010/11.

Sensitivity 3: The demand at Ballylumford power station is increased from 38.1 to 49.96 GWh/day with a revised profile from 2011/12.

Sensitivity 4: A new power station on the South-North Pipeline from 2010/11. The existing station at Poolbeg was deemed not to be operating in this case.

Sensitivity 5: A new storage facility at Larne/Ballylumford with a withdrawal and filling rate of 4 mscmd under peak demand conditions in 2011/12.

Sensitivity 6: Combined sensitivity cases for 2010/11 only:

- Addition of the Kilroot CCGT and the proposed South-North CCGT.
- The addition of Kilroot and South-North CCGTs with storage filling at 4 mscmd.

The Twynholm regulator was operated at a constant hourly flow rate over the day (i.e. the hourly flow rate is $\frac{1}{24}$ th of the daily flow) and therefore no diurnal storage is taken from the upstream system. The Carrickfergus regulator was allowed to flow freely; hence the flows through this regulator are controlled by the prevailing pressures in the system.

3.2 BASE CASE RESULTS

Table 4.1 System in Scotland

Year	Moffat Flow (mscmd)	Beattock Discharge Pressure (barg)	Twynholm		Brighthouse Bay		South-North Flow (mscmd)
			Upstream Pressure (barg)	Flow (mscmd)	Inlet Pressure (barg)	Flow (mscmd)	
Limits		85	56 (Min)	8.08	52 (Min)	23	-
2007/8	27.39	85	72.6	7.55	70.1	19.85	0
2008/9	28.37	85	71.5	7.67	68.8	20.70	0
2009/10	20.59	85	78.8	8.02	77.7	12.57	0
2010/11	22.63	85	77.2	8.08	75.8	14.55	0.14
2011/12	24.50	85	75.5	8.08	73.8	16.42	0.34
2012/13	18.04	85	80.5	8.08	79.7	9.97	0.51
2013/14	16.89	85	81.2	8.08	80.5	8.81	0.70

Table 4.2 Northern Ireland conditions

Year	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow ⁽⁵⁾ (mscmd)	B'lumford Pressure ⁽³⁾ Min / Max (barg)	C'keeragh Pressure ⁽²⁾ Min / Max (barg)
		Pressure ⁽⁴⁾ Min / Max (barg)	Flow (mscmd)			
Limits	56 / 75	85 (Max)				30 (Min)
2007/8	64.8 / 70.2	38.9 / 48.6	0	1.95	40.4 / 51.4	33.0 / 43.3
2008/9	63.7 / 69.0	35.6 / 45.7	0	2.07	37.4 / 48.9	29.1 / 39.9
2009/10	69.5 / 75.0	42.2 / 52.4	0	2.35	44.2 / 55.6	36.6 / 47.3
2010/11	68.4 / 74.1	39.8 / 50.5	0.14	2.30	41.9 / 53.8	33.8 / 45.0
2011/12	67.3 / 73.0	38.0 / 49.1	0.34	2.21	40.0 / 52.3	31.4 / 43.2
2012/13	69.0 / 75.0	41.3 / 52.3	0.51	2.16	42.9 / 55.2	34.8 / 46.5
2013/14	68.8 / 75.0	41.3 / 52.6	0.70	2.09	42.6 / 55.2	34.4 / 46.4

Pressures are satisfactory throughout although in 2008/09 the Coolkeeragh pressure has dropped just below the 30barg limit. It is not considered that this will create any practical problems.

Previous work has shown that the SNIP system can transport gas at levels above the 8.08 contractual flow rate and the table overleaf shows the maximum level possible based on a 30 barg minimum pressure at Coolkeeragh. All pressures elsewhere on the system are well above the minimum allowable levels. The analysis shows that if the system is operated in this manner no gas needs to flow up the south-north pipeline until 2011/12 which is a delay of one year from the timing in the case where the contractual flow limit is applied. This is on the basis that suitable pressures prevail upstream of Twynholm.

Year	Maximum Twynholm Flow	South-North Flow
	mscmd	Mscmd
2007/8	7.55	0
2008/9	7.67	0
2009/10	7.86	0
2010/11	8.06	0
2011/12	8.26	0.24
2012/13	8.42	0.07
2013/14	8.61	0.31

4 DISCUSSION

The main result from this report is that the pressure service available in Northern Ireland is sufficient to meet the shipper's requirements as analysed in the base case when Corrib is delivered in time for the 2009/10 winter. However if the delivery of gas from the Corrib field is delayed then, under the existing commercial arrangements, with peak demand, interruption of power generation may be necessary. Alternatively, measures could be taken to ensure that pressures are maintained at adequate levels, such as:-

- operate under pressure control at Twynholm
- operate Carrickfergus as a free flow installation
- bring gas through the IC and up the south-north pipeline

The introduction of a new 400MW station at Kilroot can be accommodated but it would create the need to flow volumes of gas via the South-North pipeline to sustain pressures at a satisfactory level.

If the peak flow rate at Ballylumford power station is increased, satisfactory pressures can be maintained without any modification needed to the way the system operates except from the year 2013/14 and this could be addressed by adjusting the balance of flows.

Enquiries have been received in the past year about the possible connection of a new CCGT power station off the South-North pipeline. This station can be supplied without creating any pressure problems in Northern Ireland but it should be noted that there is a flow up the South-North Pipeline created as a consequence of the addition of this load to the system.

Underground salt deposits exist in Northern Ireland close to Larne and these are currently being investigated for their suitability for gas storage. A base injection/withdrawal rate of 4mscm/d was adopted in this study and the effect of this was analysed under peak day conditions. Withdrawing gas from the facility did not create any problems although the flow through Twynholm was reduced and no gas was required to flow up the south-north pipeline. Injecting gas did however create difficulties but it was determined that use of the south-north pipeline could maintain adequate pressures although the flow rate up this line was over 5mscmd. Further analysis would be advised.

A number of combined sensitivity cases were considered to test the capability of the system to meet maximum conditions. One case modelled the base system with the addition of two new power stations (on the South-North pipeline and at Kilroot) and the storage at Larne. A

total flow of around 16mscmd could be transported through the system, and pressures maintained, although it was necessary to operate Twynholm as a pressure controlled station to sustain pressures at Coolkeeragh.

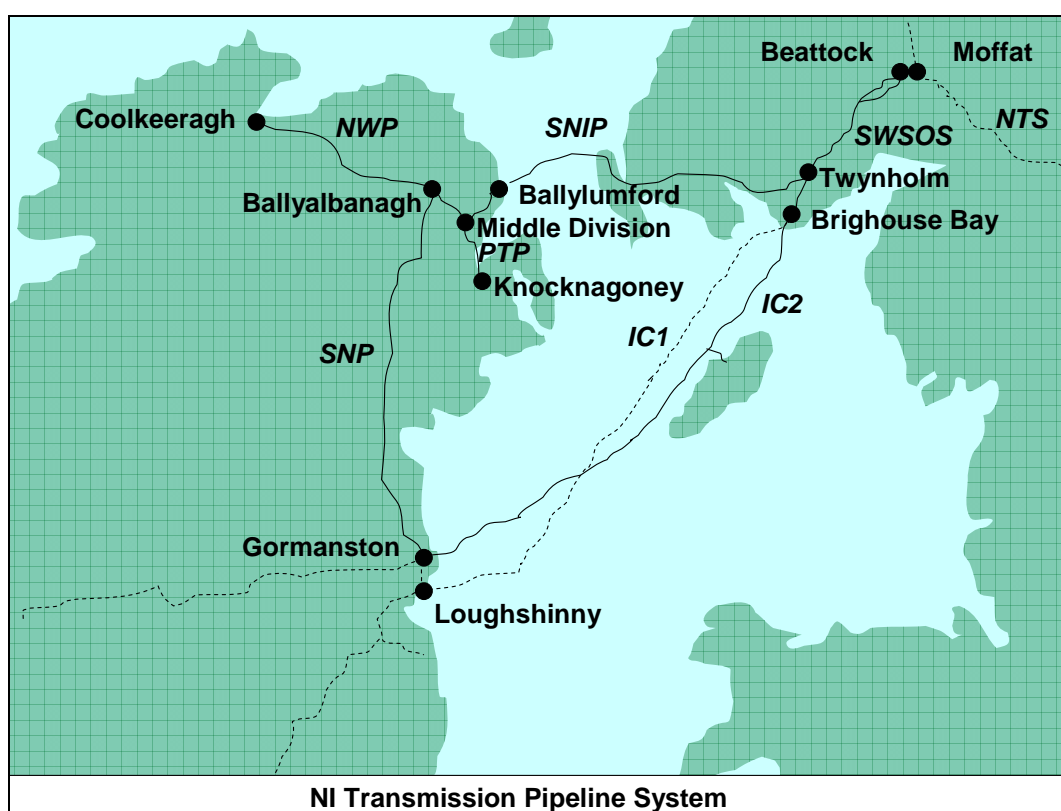
- IMPORTANT NOTICE

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5 APPENDIX 1 – NETWORK DESCRIPTION

The BGÉ high pressure transmission network conveys gas from two entry points to directly connected customers and distribution networks throughout Ireland, as well as to connected systems at exit points in Scotland (the Scotland-Northern Ireland Pipeline), and the Isle of Man. The Moffat entry point, located onshore in Scotland, connects the Irish natural gas system to that belonging to National Grid in the UK, and allows for the importation of UK gas to Ireland via two sub-sea interconnectors.

The Scotland to Northern Ireland 600mm pipeline (SNIP) connects to the BGÉ system at Twynholm in Scotland and has a maximum operating pressure of 75 barg. The pipeline is 135 km long and runs towards the coast near Stranraer and crosses the Irish Sea to terminate at Ballylumford Power Station, Island Magee. SNIP is owned and operated by Premier Transmission Ltd. The layout of this part of the system is shown in the diagram below.



The Phoenix Transmission Pipeline (PTP) comprises a further 35kms of 600mm pipeline with a maximum operating pressure of 75 Barg and runs from Ballylumford via Carrickfergus to Belfast.

From Carrickfergus 112km of 450mm pipeline have recently been constructed to supply the power station at Coolkeeragh, Londonderry. This pipeline, the North-West Pipeline (NWP), is owned and operated by BGE (UK) Ltd. As well as Coolkeeragh, several distribution networks are being developed in towns adjacent to the pipeline by Firmus Energy.

A 450mm pipeline connecting the Interconnector System to the North-West Pipeline was built in 2006. This pipeline, called the South-North Pipeline (SNP), is 154.5 km long and

extends from the IC2 landfall at Gormanston, Co. Meath in the Republic of Ireland to Ballyalbanagh on the North - West Pipeline, approximately 12km west of the Carrickfergus AGI. This pipeline will facilitate supplies to towns and industries in the corridor from Newry to Belfast (also being developed by Firmus) and in the longer term will be able to support the SNIP pipeline in meeting increased demand levels in Northern Ireland. The SNP was developed by BGE (UK) Ltd and is included in the NI postalised transmission system.

The South-North pipeline supplies the following towns:-

- Newry
- Banbridge
- Lurgan
- Craigavon
- Portadown
- Lisburn/Sth. Belfast
- Antrim

A new pipeline is planned to be constructed from Kernan to Armagh to supply gas initially to Armagh.

6 APPENDIX 2 – MODEL ASSUMPTIONS

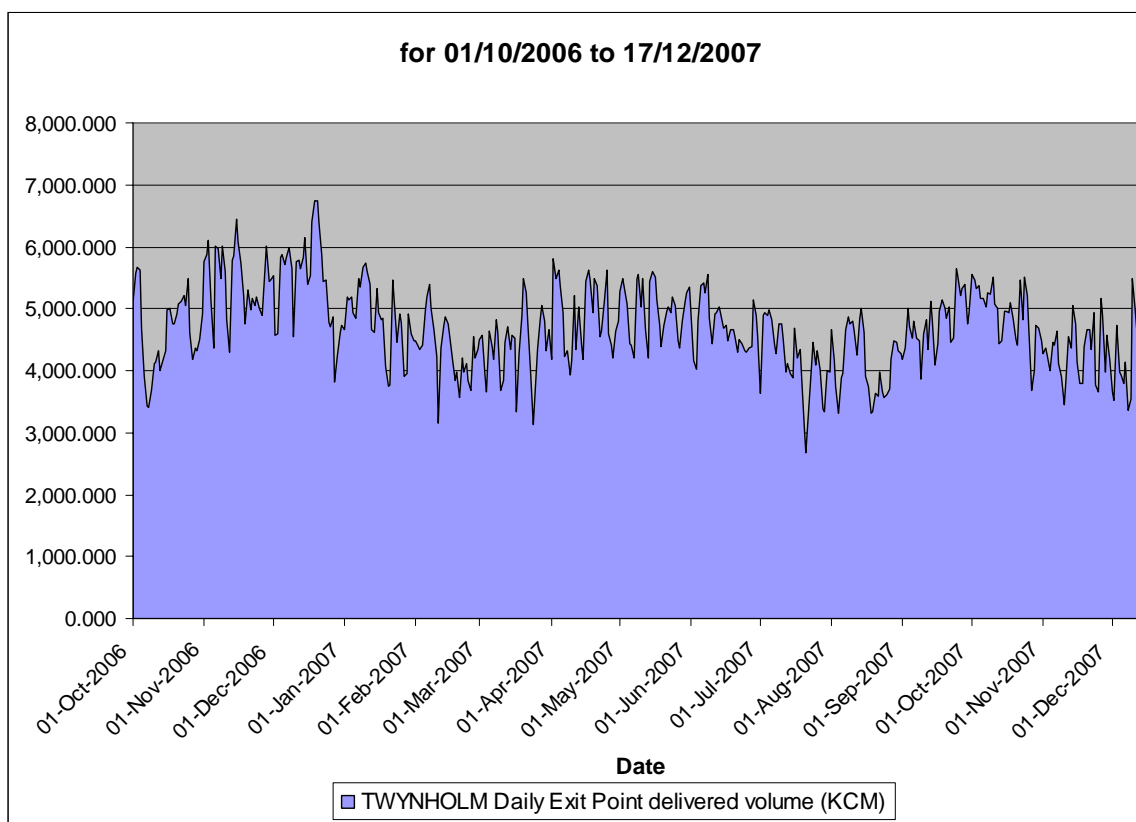
The network analysis model has been built incorporating the following features:

- The base case and sensitivity scenarios have been studied by simulating the 24-hour demand cycle over a period of 3 days to obtain repeatable results over the day.
- All demands are modelled in energy terms. Volumetric flow is calculated by the network analysis program by applying relevant gas calorific value. The RoI demands are published in the 2006 Gas Capacity statement, the Northern Ireland demands have been updated with new information received from the PS gas suppliers in August 2007.
- Full gas quality tracking is implemented to track changes in gas compositions throughout the network to allow computation of delivered gas calorific value.
- The SNIP system, North-West and South-North Pipelines are modelled to the same level of detail as the RoI system. Northern Ireland is entitled to offtake 8.08mscmd at Twynholm and the capacity of Twynholm AGI is understood to be 8.64mscmd. The performance of the system in the base case was modelled both with the flows restricted to the contractual maximum and also in the case when the SNIP system was permitted to flow at the maximum level possible. The capacity of the SNIP System is dependant on a number of factors including the off-take profiles and the downstream pressure at Twynholm.
- Maximum discharge pressure from Twynholm into the SNIP system is 75 barg; the contractual minimum pressure upstream of Twynholm is 56 barg. Pressure in SNIP system is controlled by the downstream pressure available at Twynholm as there is an obligation to supply at the prevailing pressure. The pressure at Twynholm in turn depends on the condition in the Onshore Scotland system. The suction pressure at Beattock is assumed to be 45 barg.
- The design pressure of the South-North Pipeline is 85 barg via the appropriate facilities at Gormanston.

- For flows of greater than 26 mscmd through Moffat, the Beattock Station discharge pressure will be based on a report previously commissioned from PLE to determine Beattock compressor station handling capabilities with flows greater than the design flow.
- Pressure losses of 2 barg have been adopted for modelling purposes across the Carrickfergus and Ballyalbanagh installations and 2.5 barg at the Twynholm regulator installation.

APPENDIX 3 – TWYNHOLM FLOWS 2006/2007

The graph below shows the flows through Twynholm over the period from the 1st of October 2006 to the 16th of December 2007. It shows a peak flow rate of 6.75mscmd in the winter of 2006 which is below the forecast peak for that winter under 1 in 20 conditions. However the winter did not approach this level of severity and it is not considered that these results invalidate the demand forecasts.



APPENDIX 4 - SCENARIO RESULTS

Sensitivity 1 - Corrib delayed until 2010/11

Supplies

Year	Peak Day Supply Flows (mscmd)		
	Moffat	Inch	Corrib
2009/10	30.00	3.36	0

The following tables summarise the critical results obtained for this case for onshore Scotland and Northern Ireland.

Year	Moffat Flow (mscmd)	Beattock Discharge Pressure (barg)	Twynholm		Brighthouse Bay		South-North Flow (mscmd)	Reinforcement ⁽¹⁾
			Upstream Pressure (barg)	Flow (mscmd)	Inlet Pressure (barg)	Flow (mscmd)		
Limits		85	56 (Min)	8.08	52 (Min)	23		
2009/10	30.00	85	69.6	8.02	66.5	21.98	0	-
		85	82.5	8.02	82.1	21.98	0	2

Notes:

1. Reinforcement:

1 – Beattock Station Upgrade to provide 85 barg discharge pressure.

2 – On-shore Scotland Pipeline loop from Cluden to Brighthouse Bay Station.

Year	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow (mscmd)	B'lumford Pressure Min / Max (barg)	C'keeragh Pressure Min / Max (barg)	Reinforcement ⁽¹⁾
		Pressure Min / Max (barg)	Flow (mscmd)				
Limits	56 / 75	85 (Max)				30 (Min)	
2009/10	62.1 / 67.2	27.7 / 39.0	0	2.35	30.6 / 43.6	19.6 / 32.4	-
	69.5 / 75.0	42.2 / 52.4	0	2.35	44.2 / 55.7	36.6 / 47.3	2

These results show that if the system is operated in this way then pressures at Coolkeeragh will fall below the minimum acceptable level in 2009/10. Analysis shows that pressures can be restored by reinforcing the onshore system in Scotland.

Another alternative solution is to transport less gas to Northern Ireland via the SNIP system and to make more use of the recently completed south-north pipeline. The system was operated in such a way that the net flow through Carrickfergus was zero over the day. However a range of operational options are available to maintain adequate pressures and the results of the analysis tabulated below in the two following tables should be considered as indicative results for the system.

Year	Moffat Flow (mscmd)	Beattock Discharge Pressure (barg)	Twynholm		Brighthouse Bay		South-North Flow (mscmd)	Reinforcement ⁽¹⁾
			Upstream Pressure (barg)	Flow (mscmd)	Inlet Pressure (barg)	Flow (mscmd)		
Limits		85	56 (Min)	8.08	52 (Min)	23		
2009/10	30.00	85	69.6	5.67	65.8	24.33	2.35	-

Year	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow (mscmd)	B'lumford Pressure Min / Max (barg)	C'keeragh Pressure Min / Max (barg)	Reinforcement
		Pressure Min / Max (barg)	Flow (mscmd)				
Limits	56 / 75	85 (Max)				30 (Min)	
2009/10	60.3 / 67.2	52.9 / 61.2	2.35	0	46.5 / 57.2	41.0 / 51.4	-

Sensitivity 2 – A new 400MW CCGT station at Kilroot from 2010/11 onwards

The performance of the system was analysed with the addition of a new 400MW CCGT powers station at Kilroot which is 5km from the Carrickfergus AGI. The supplies into the system in this case are tabulated below. The additional gas is taken through the supply point at Moffat.

Results of the analysis for the four year period are shown in the next table.

Year	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow ⁽⁵⁾ (mscmd)	B'lumford Pressure ⁽³⁾ Min / Max (barg)	C'keeragh Pressure ⁽²⁾ Min / Max (barg)	Reinforcement ⁽¹⁾
		Pressure ⁽⁴⁾ Min / Max (barg)	Flow (mscmd)				
Limits	56 / 75	85 (Max)				30 (Min)	
2010/11	67.4 / 73.0	43.7 / 53.3	1.84	0.60	40.0 / 52.3	32.5 / 44.4	-
2011/12	65.7 / 71.4	41.9 / 51.7	2.04	0.51	37.1 / 49.8	28.7 / 41.5	-
2012/13	68.9 / 75.0	47.8 / 57.4	2.21	0.46	42.7 / 55.2	35.5 / 47.5	-
2013/14	68.8 / 75.0	48.4 / 58.1	2.39	0.39	42.4 / 55.2	34.9 / 47.5	-

These results show that the minimum pressure at Coolkeeragh is adequate in all years apart from 2011/12 when the pressure drops slightly below the minimum level of 30 barg. However in practice this is very unlikely to create problems and the pressures can be improved by allowing slightly more gas to flow up the south –north pipeline. It is worth noting that the results show that this new station creates a need to flow significant volumes of gas to Northern Ireland by this route.

Sensitivity 3 - Ballylumford power station demand is increased from 38.1 to 49.96 GWh/day from 2011/12 onwards

The years analysed in this case were 2009/10 and 2012/13. The table below summarises the results for this scenario.

Year	Twynholm Pressure (Max) (Barg)	Gormanston (South-North)		C'fergus Flow (mscmd)	B'lumford Pressure (Min) (Barg)	C'keeragh Pressure (Min) (Barg)
		Pressure (Max) / (Min) (Barg)	Flow (mscmd)			
Limits	75 (Max)	30 (Min)			27 (Min)	27 (Min)
2009/10	68.7	46.7 / 37.3	1.08	1.13	40.6	32.7
2012/13	68.8	47.9 / 38.2	1.38	1.11	40.5	32.0

Sensitivity 4 - A new power station situated on the South-North Pipeline from 2010/11

In the past year enquiries have been made regarding a potential new power station located near the south-north pipeline. The effect of this possible power station was considered a sensible sensitivity case to analyse.

The supply position and the results of the analysis are listed is tabulated in the following tables

Year	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow ⁽⁵⁾ (mscmd)	B'lumford Pressure Min / Max (barg)	C'keeragh Pressure Min / Max (barg)	Reinforce- ment
		Pressure Min / Max (barg)	Flow (mscmd)				
Limits	56 / 75	85 (Max)				30 (Min)	
2010/11	68.4 / 74.1	41.7 / 52.0	1.77	2.30	41.9 / 53.8	33.7 / 45.0	-
2011/12	67.3 / 73.0	40.3 / 50.9	2.09	2.21	39.9 / 52.3	31.3 / 43.2	-
2012/13	69.0 / 75.0	43.7 / 54.3	2.26	2.16	42.9 / 55.2	34.7 / 46.5	-
2013/14	68.8 / 75.0	44.0 / 54.7	2.44	2.09	42.7 / 55.2	34.4 / 46.4	-

Sensitivity 5 - a salt cavity storage facility situated at Larne

Suitable deposits of salt exist near to Ballylumford power station which can be leached to create cavities than can be used for gas storage. This is unlikely to be available before 2011/12. The system capability was tested under peak day conditions with results shown in the following two tables.

Storage Direction	Moffat Flow ⁽⁶⁾ (mscmd)	Beattock Discharge Pressure (barg)	Twynholm		Brighthouse Bay ⁽³⁾		South-North Flow (mscmd)	Storage Volume
			Upstream Pressure (barg)	Flow ⁽²⁾ (mscmd)	Inlet Pressure (barg)	Flow (mscmd)		
		85	56 (Min)	8.08	52 (Min)	23		
To	28.50	85	71.4	8.08	68.7	20.42	4.34	4
From	20.50	85	78.8	4.42	77.2	16.07	0	(4)

Storage Direction	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow ⁽⁵⁾ (mscmd)	B'lumford Pressure ⁽³⁾ Min / Max (barg)	C'keeragh Pressure ⁽²⁾ Min / Max (barg)	Reinforce- ment
		Pressure ⁽⁴⁾ Min / Max (barg)	Flow (mscmd)				
	56 / 75	85 (Max)				30 (Min)	
To	63.0 / 68.8	58.1 / 64.3	4.34	-1.79	31.5 / 46.0	24.9 / 39.6	-
From	66.9 / 75.0	58.3 / 67.2	0	2.55	60.0 / 70.1	53.7 / 62.9	-

No significant problems are experienced when exporting gas from the system in terms of pressures but supplying gas from this point does have the effect of reducing flows into the system via the Moffat supply point. In the unlikely event of having to fill the cavity under peak day conditions it is necessary for the south-north pipeline to flow gas at high rates and even so pressures at Coolkeeragh are below the minimum level. Further analysis shows that this can be overcome by rebalancing the system to transport even more gas up the south-north pipeline. At a flow rate of 5.06 mscmd the minimum pressure at Coolkeeragh is increased to 32.4 barg.

Sensitivity 6 - combined sensitivity cases

The following combined sensitivity cases were considered with the objective of determining the capacity limits of the existing system. These combined cases are as follows:

1. Addition of Kilroot and south-north power station in 2010/11.
2. Addition of Kilroot and south-north power stations with storage filling at 4 mscmd in 2011/12.

Sensitivity	Twynholm Pressure Min / Max (barg)	Gormanston (South-North)		C'fergus Flow (mscmd)	B'lumford Pressure Min / Max (barg)	C'keeragh Pressure Min / Max (barg)	Reinforce- ment ⁽¹⁾
		Pressure Min / Max (barg)	Flow (mscmd)				
Limits	56 / 75	85 (Max)				30 (Min)	
Combo 1	67.4 / 73.0	48.1 / 56.8	3.59	0.60	40.1 / 52.3	32.5 / 44.4	-
Combo 5	60.7 / 66.8	79.5 / 83.4	7.79	-3.49	26.2 / 42.8	21.6 / 36.9	-
	65.8	85.0	7.93	-3.62	31.3 / 48.5	27.3 / 43.5	P
	61.5 / 66.9	74.5 / 79.8	6.59	-2.29	43.1 / 54.9	38.1 / 49.7	3

Notes:

Reinforcement:

1 – Beattock Station Upgrade to provide 85 barg discharge pressure.

2 – On-shore Scotland Pipeline loop from Cluden to Brighthouse Bay Station.

3 – SNIPs looped between Twynholm and South Cairn.

P – Pressure control at Twynholm and Gormanston (South-North); no reinforcement of Beattock Compressor Station or Onshore Scotland Pipeline.

Demand growth beyond the analysis period may indicate benefits of early implementation of both reinforcement modes.

Reinforcement is introduced to ensure simulation conditions are met in individual years. In practice, where reinforcement is made, “later years” would improve.