Appendix D - Transmission System Design Summary

Pipeline Run No.	Description	Nominal Diameter (mm)	Approx. Length (km)	Design Flow (kSCMH)	Design Pressure (bar)	Design Temperature (℃)	
						Max	Min
2	Derryhale AGI - Dungannon AGI	250	28	48	85	7	0
3	Dungannon AGI - Cookstown AGI	150	17	13	85	7	0
4	Dungannon AGI - Omagh AGI	250	38	23	85	7	0
5	Omagh AGI - Enniskillen AGI	200	35	12	85	7	0
6	Enniskillen AGI - Derrylin AGI	200	23	6	85	7	0
7	North-West Pipeline - Strabane AGI	150	28	7.5	85	7	0

Compression Requirements

At this time it is not possible to predict what the operational requirements of the network will be in Year 9 (2020) or if the minimum operating will remain as low as 35bar. However, to establish an order of magnitude as to the level of Capital Expenditure and Operational expenditure that may be required should this inlet pressure to the proposed network remain the following was considered:

- Maximum Flow Rate: 50 KSCMH
- Minimum Inlet Pressure: 35bar
- Minimum Outlet Pressure: 50bar
- Compression Energy Required: 500kW
- Efficiency: 60%
- Power Required: 850kW

In order to provide the required compression associated with the flow in the proposed network 2No 1MW compressors together with associated equipment will be required. The estimated capital cost being circa £8 Million +/- 20% with an annual operational cost (including gas usage) of approximately £450K - £500K.

Appendix D - Transmission System Design

Description: North-South pipeline offtake to Derryhale AGI

Run No.: 1

Inlet pressure	P'_1	=	50	bar gauge =	5,000,000	N/m^2
Load	q'_h	=	48,000	SCMH =	0.27	m^3/s
Pipe friction factor	f	=	0.0140			
Pipeline length	L_m	=	1	km =	1,000	m
Gas absolute temperature	T	=	278	Deg K =	5	℃
Specific Gravity	S_g	=	0.6392			
Pipeline diameter	d	=	273.0	mm =	250	NB
Pipeline wall thickness	t	=	9.27	mm		
Outlet pressure	P'_2	=	**50**	**bar gauge**	4,970,910	N/m^2
Pressure Drop		=	**0.29**	**bar**	1%	pressure drop

Velocity		
Q =	0.257	m^3/s
A =	0.051	m^2
Giving, v =	**5.06**	**m/s**
Sizing pipe based on 11m/s:		
Q =	*0.26*	*m^3/s*
v =	*11*	*m/s*
A =	*0.023*	*m^2*
giving, d=	*0.1726*	*m*

Wall Thickness (minimum required)			
P =	50.00	bar gauge	
D =	273	mm	
f =	0.72	(0.3 type S or 0.72 type R)	
Grade =	x42		
giving s =	290	N/mm^2	
& Finally t =	**3.27**	**mm**	***therefore WT used is OK***
Actual Design Factor:	*0.25*		

3. Location classification to determine f (design factor)

R = rural areas, </= 2.5 persons/hectare = 2.47 acres
S = intermediate area, >2.5 persons/hectare but not all T type conditions
T = a) high population density
b) ay multiple storey buildings
c) dense traffic
d) numerous underground services
R/S/T Classification based on above & from mapping/aerials? **R**

4. Proximity Requirements (determined from Design Factor f)

Design Factor	0.72	
Design Pressure	**85**	
Proximity requirements:	**21**	**metres**

Description: Derryhale AGI to Dungannon AGI offtake

Run No.: 2

Inlet pressure	P'_1	=	50	bar gauge =	4,970,910	N/m^2
Load	q'_h	=	48,000	SCMH =	0.27	m^3/s
Pipe friction factor	f	=	0.0140			
Pipeline length	L_m	=	28	km =	28,000	m
Gas absolute temperature	T	=	278	Deg K =	5	℃
Specific Gravity	S_g	=	0.6392			
Pipeline diameter	d	=	273.0	mm =	250	NB
Pipeline wall thickness	t	=	9.27	mm		
Outlet pressure	P'_2	=	**41**	**bar gauge**	4,072,892	N/m^2
Pressure Drop		=	**8.98**	**bar**	18%	pressure drop

Velocity		
Q =	0.259	m^3/s
A =	0.051	
Giving, v =	**5.09**	**m/s**
Sizing pipe based on 11m/s:		
Q =	*0.26*	*m^3/s*
v =	*11*	*m/s*
A =	*0.024*	*m^2*
giving, d=	*0.1731*	*m*

Wall Thickness (minimum required)			
P =	49.71	bar gauge	
D =	273	mm	
f =	0.72	(0.3 type S or 0.72 type R)	
Grade =	B		
giving s =	245	N/mm^2	
& Finally t =	**3.85**	**mm**	***therefore WT used is OK***
Actual Design Factor:	*0.30*		

3. Location classification to determine f (design factor)

R = rural areas, </= 2.5 persons/hectare = 2.47 acres
S = intermediate area, >2.5 persons/hectare but not all T type conditions
T = a) high population density
b) ay multiple storey buildings
c) dense traffic
d) numerous underground services
R/S/T Classification based on above & from mapping/aerials? **R**

4. Proximity Requirements (determined from Design Factor f)

Design Factor	0.72	
Design Pressure	**85**	
Proximity requirements:	**21**	**metres**

Description: Dungannon AGI to Cookstown AGI

Run No.: 3

Inlet pressure	P'_1	=	41	bar gauge =	4,072,892	N/m^2
Load	q'_h	=	13,000	SCMH =	0.09	m^3/s
Pipe friction factor	f	=	0.0150			
Pipeline length	L_m	=	17	km =	17,000	m
Gas absolute temperature	T	=	278	Deg K =	5	℃
Specific Gravity	S_g	=	0.6392			
Pipeline diameter	d	=	168.3	mm =	150	NB
Pipeline wall thickness	t	=	7.11	mm		
Outlet pressure	P'_2	=	**34**	**bar gauge**	3,439,165	N/m^2
Pressure Drop		=	**6.34**	**bar**	16%	pressure drop

Velocity		
Q =	0.086	m^3/s
A =	0.019	
Giving, v =	**4.59**	**m/s**
Sizing pipe based on 11m/s:		
Q =	*0.09*	*m^3/s*
v =	*11*	*m/s*
A =	*0.008*	*m^2*
giving, d=	*0.0995*	*m*

Wall Thickness (minimum required)			
P =	40.73	bar gauge	
D =	168.3	mm	
f =	0.72	(0.3 type S or 0.72 type R)	
Grade =	B		
giving s =	245	N/mm^2	
& Finally t =	**1.94**	**mm**	***therefore WT used is OK***
Actual Design Factor:	*0.20*		

3. Location classification to determine f (design factor)

R = rural areas, </= 2.5 persons/hectare = 2.47 acres
S = intermediate area, >2.5 persons/hectare but not all T type conditions
T = a) high population density
b) ay multiple storey buildings
c) dense traffic
d) numerous underground services
R/S/T Classification based on above & from mapping/aerials? **R**

4. Proximity Requirements (determined from Design Factor f)

Design Factor	0.72	
Design Pressure	**85**	
Proximity requirements:	**21**	**metres**

Description: Dungannon AGI to Omagh AGI

Run No.: 4

Inlet pressure	P'_1	=	41	bar gauge =	4,072,892	N/m^2
Load	q'_h	=	23,000	SCMH =	0.16	m^3/s
Pipe friction factor	f	=	0.0140			
Pipeline length	L_m	=	38	km =	38,000	m
Gas absolute temperature	T	=	278	Deg K =	5	℃
Specific Gravity	S_g	=	0.6392			
Pipeline diameter	d	=	273.0	mm =	250	NB
Pipeline wall thickness	t	=	9.27	mm		
Outlet pressure	P'_2	=	**37**	**bar gauge**	3,749,371	N/m^2
Pressure Drop		=	**3.24**	**bar**	8%	pressure drop

Velocity		
Q =	0.151	m^3/s
A =	0.051	m^2
Giving, v =	**2.98**	**m/s**
Sizing pipe based on 11m/s:		
Q =	*0.15*	*m^3/s*
v =	*11*	*m/s*
A =	*0.014*	*m^2*
giving, d=	*0.1324*	*m*

Wall Thickness (minimum required)			
P =	40.73	bar gauge	
D =	273	mm	
f =	0.72	(0.3 type S or 0.72 type R)	
Grade =	B		
giving s =	245	N/mm^2	
& Finally t =	**3.15**	**mm**	***therefore WT used is OK***
Actual Design Factor:	*0.24*		

3. Location classification to determine f (design factor)

R = rural areas, </= 2.5 persons/hectare = 2.47 acres
S = intermediate area, >2.5 persons/hectare but not all T type conditions
T = a) high population density
b) ay multiple storey buildings
c) dense traffic
d) numerous underground services
R/S/T Classification based on above & from mapping/aerials? **R**

4. Proximity Requirements (determined from Design Factor f)

Design Factor	0.72	
Design Pressure	**85**	
Proximity requirements:	**21**	**metres**

Description: Omagh AGI to Enniskillen AGI

Run No.: 5

Inlet pressure	P'_1	=	37	bar gauge =	3,749,371	N/m^2	**Velocity**			**Wall Thickness (minimum required)**				**3. Location classification to determine f (design factor)**		**4. Proximity Requirements (determined from Design Factor f)**	
Load	q'_h	=	12,000	SCMH =	0.09	m^3/s	Q =	0.086	m^3/s	P =	37.49	bar gauge		R = rural areas, </= 2.5 persons/hectare = 2.47 acres		Design Factor	0.72
Pipe friction factor	f	=	0.0140				A =	0.032		D =	219.1	mm		S = intermediate area, >2.5 persons/hectare but not all T type conditions		Design Pressure	85
Pipeline length	L_m	=	35	km =	35,000	m	Giving, v =	**2.66**	**m/s**	f =	0.72	(0.3 type S or 0.72 type R)		T = a) high population density		Proximity requirements:	**21 metres**
Gas absolute temperature	T	=	278	Deg K =	5	℃	*Sizing pipe based on 11m/s:*			Grade =	B			b) ay multiple storey buildings			
Specific Gravity	S_g	=	0.6392				*Q =*	*0.09*	m^3/s	giving s =	245	N/mm^2		c) dense traffic			
Pipeline diameter	d	=	219.1	mm =	200	NB	*v =*	*11*	*m/s*	& Finally t =	**2.33**	**mm**	***therefore WT used is OK***	d) numerous underground services			
Pipeline wall thickness	t	=	8.18	mm			*A =*	*0.008*	m^2					R/S/T Classification based on above & from mapping/aerials?	**R**		
Outlet pressure	P'_2	=	**35**	**bar gauge**	3,475,859	N/m^2	*giving, d=*	*0.0997*	*m*	*Actual Design Factor:*			*0.20*				
Pressure Drop		=	**2.74**	**bar**	7%	*pressure drop*											

Description: Enniskillen AGI to Derrylin AGI

Run No.: 6

Inlet pressure	P'_1	=	35	bar gauge =	3,475,859	N/m^2	**Velocity**			**Wall Thickness (minimum required)**				**3. Location classification to determine f (design factor)**		**4. Proximity Requirements (determined from Design Factor f)**	
Load	q'_h	=	6,000	SCMH =	0.05	m^3/s	Q =	0.046	m^3/s	P =	34.76	bar gauge		R = rural areas, </= 2.5 persons/hectare = 2.47 acres		Design Factor	0.72
Pipe friction factor	f	=	0.0150				A =	0.019		D =	168.3	mm		S = intermediate area, >2.5 persons/hectare but not all T type conditions		Design Pressure	85
Pipeline length	L_m	=	22	km =	22,000	m	Giving, v =	**2.48**	**m/s**	f =	0.72	(0.3 type S or 0.72 type R)		T = a) high population density		Proximity requirements:	**21 metres**
Gas absolute temperature	T	=	278	Deg K =	5	℃	*Sizing pipe based on 11m/s:*			Grade =	B			b) ay multiple storey buildings			
Specific Gravity	S_g	=	0.6392				*Q =*	*0.05*	m^3/s	giving s =	245	N/mm^2		c) dense traffic			
Pipeline diameter	d	=	168.3	mm =	150	NB	*v =*	*11*	*m/s*	& Finally t =	**1.66**	**mm**	***therefore WT used is OK***	d) numerous underground services			
Pipeline wall thickness	t	=	7.11	mm			*A =*	*0.004*	m^2					R/S/T Classification based on above & from mapping/aerials?	**R**		
Outlet pressure	P'_2	=	**33**	**bar gauge**	3,281,653	N/m^2	*giving, d=*	*0.0732*	*m*	*Actual Design Factor:*			*0.17*				
Pressure Drop		=	**1.94**	**bar**	6%	*pressure drop*											

Description: North-West pipeline offtake to Strabane AGI

Run No.: 7

Inlet pressure	P'_1	=	50	bar gauge =	5,000,000	N/m^2	**Velocity**			**Wall Thickness (minimum required)**				**3. Location classification to determine f (design factor)**		**4. Proximity Requirements (determined from Design Factor f)**	
Load	q'_h	=	7,500	SCMH =	0.04	m^3/s	Q =	0.040	m^3/s	P =	50.00	bar gauge		R = rural areas, </= 2.5 persons/hectare = 2.47 acres		Design Factor	0.72
Pipe friction factor	f	=	0.0150				A =	0.019		D =	168.3	mm		S = intermediate area, >2.5 persons/hectare but not all T type conditions		Design Pressure	85
Pipeline length	L_m	=	28	km =	28,000	m	Giving, v =	**2.16**	**m/s**	f =	0.72	(0.3 type S or 0.72 type R)		T = a) high population density		Proximity requirements:	**21 metres**
Gas absolute temperature	T	=	278	Deg K =	5	℃	*Sizing pipe based on 11m/s:*			Grade =	B			b) ay multiple storey buildings			
Specific Gravity	S_g	=	0.6392				*Q =*	*0.04*	m^3/s	giving s =	245	N/mm^2		c) dense traffic			
Pipeline diameter	d	=	168.3	mm =	150	NB	*v =*	*11*	*m/s*	& Finally t =	**2.39**	**mm**	***therefore WT used is OK***	d) numerous underground services			
Pipeline wall thickness	t	=	7.11	mm			*A =*	*0.004*	m^2					R/S/T Classification based on above & from mapping/aerials?	**R**		
Outlet pressure	P'_2	=	**47**	**bar gauge**	4,731,829	N/m^2	*giving, d=*	*0.0682*	*m*	*Actual Design Factor:*			*0.24*				
Pressure Drop		=	**2.68**	**bar**	5%	*pressure drop*											