PURPOSE **To provide methods to determine the approximate blowdown volume, time, valve size and piping size for pipeline design and analysis applications. Also provides methods to determine the amount of gas vented to atmosphere and the amount of gas saved due to blowdown reduction for a controlled blowdown situation are also provided.**

1. POLICY AND SCOPE

1.1. Transmission and Distribution pipeline systems with a maximum allowable operating pressure (MAOP) that produces a hoop stress of 20% or higher of the specified minimum yield strength (SMYS) require blowdown valves between mainline valves. Refer to GS 180.0085, *Valve Usage and Selection Guide.*

1.2. The time estimated to blow down the pipeline must comply with regulations regarding specified location classes as outlined in the document referenced above.

1.3. This Gas Standard is valid for determining the volume of gas lost to atmosphere in controlled (shut in) blowdown situations. Uncontrolled blowdown situations, such as damage or relief valve operation, are not covered in this Gas Standard. Refer toGS 182.0155, *Gas Lost Estimation – Pipeline.*

1.4. Prior to the blowdown, an estimation of projected volume loss may be required by **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations**. If any of the conditions listed below, please complete the Form 7011, *Blowdown Emission Reduction Plan*:

1.4.1. Blowdown due to the shutdown, replacement, and/or abandonment of transmission pipelines or distribution mains operating over 60 PSIG.

1.4.2. Blowdown due to in-line inspection (ILI) operations. For these operations, document the cumulative planned blowdown volume per project.

1.4.3. Blowdown due to the shutdown, replacement, and/or abandonment of distribution mains 6-inch diameter or larger and 1,000-feet or greater in length, operating at a pressure of 60 PSIG and under.

1.4.4. Any other blowdown operation not included above that will result in a gas loss of 10 MSCF (1 MSCF = 1,000 standard cubic feet) or more, before any methane emissions reduction. This also includes gas used during Company operations (including Storage Operations). For these operations, document the cumulative planned blowdown volume per project.

1.5. If required, the following must be determined and documented in the Form 7011, *Blowdown Emission Reduction Plan.*

1.5.1. The planned volume of gas to be blown to the atmosphere.

1.5.2. The planned volume of gas saved due to blowdown reduction methods or approaches.

1.6. Upon completion of the blowdown, the following must be reported for a volume loss of 10 MSCF or greater, before methane reduction, by **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations**, as required in the Form 3466, *Reporting of Gas Blown to Atmosphere.*

1.6.1. The calculated volume of gas blown to atmosphere.

1.6.2. The calculated volume of gas saved due to blowdown reduction methods or approaches.

2. RESPONSIBILITIES AND QUALIFICATIONS

2.1. **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations** are responsible for determining the size of blowdown piping and stacks in accordance with the regulations outlines inGS 180.0085, *Valve Usage and Selection Guide.*

2.2. **Gas Transmission Planning** will provide technical assistance as required by **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations**, including gas loss calculations for complex situations not covered in GS 182.0155, *Gas Lost Estimation – Pipeline.*

3. DEFINITIONS

3.1. Blowdown – A controlled release of natural gas by reducing the pipeline pressure to a lower specified pressure.

3.2. Blowdown Reduction – The method and/or approach used in reducing the pressure in the pipeline segment prior to the blowdown event. Examples include, but are not limited to, the following.

3.2.1. Cross Compression – As defined in GS 223.0155, *Planning Pipeline Blowdowns and Reporting.*

3.2.2. CNG Capture (Tanking) – As defined in GS 223.0155, *Planning Pipeline Blowdowns and Reporting.*

3.2.3. Draw Down Pressure - As defined in GS 223.0155, *Planning Pipeline Blowdown and Reporting.*

3.2.4. Diverting to Other Local Lines – As defined in GS 223.0155, *Planning Pipeline Blowdown and Reporting.*

3.2.5. Volume Reduction via Pressure Control Fittings – As defined in GS 223.0155, *Planning Pipeline Blowdown and Reporting.*

3.2.6. Thermal Oxidizer – As defined in GS 223.0155, *Planning Pipeline Blowdown and Reporting.*

4. PROCEDURE

4.1. **Blowdown Time**

4.1.1. The following parameters are needed to determine the approximate time required to blowdown a pipeline through a valve.

4.1.1.1. Internal diameter of the pipeline.

4.1.1.2. Blowdown valve opening and internal diameter of blowdown piping.

4.1.1.3. Shut-in pressure of the pipeline.

4.1.1.4. Length of pipeline to be blown down.

4.1.1.5. Shut in gas temperature.

4.1.1.6. Gas specific gravity.

4.1.1.7. Valve opening %.

Note: The actual time to blow down the pipeline will be slightly longer due to the time required to open the blowdown valve.

4.2. **Correction Factors**

4.2.1. The following corrections factors are used, if applicable.

4.2.1.1. For valve openings other than 100%, $\mathbf{K_O} = \frac{100\%}{\%\ \text{opening}}$

> **Note:** If more information is not available, use a 40% opening for plug valves. Use 100% for fully opened ball valves. Throttled ball valves should have a percent opening value less than 100%. If plug/or ball valve must be partially open for blowdown, see valve specifications for opening diameter.

4.2.1.2. For specific gravity other than 0.60, $\mathbf{K_{SG}} = \sqrt{\frac{Sp.Gr.}{0.60}}$

4.2.1.3. For shut-in temperatures other than 60°F, $\mathbf{K_T} = \sqrt{\frac{T+460}{520}}$, where T is the gas temperature in degrees Fahrenheit.

4.3. Time Required to Blow Down

4.3.1. To determine the approximate time required to blow down a pressurized pipeline to atmospheric pressure through a full opening valve (refer to **Section 4.2** above for applicable correction factors), the following equation is applied:

$$t = 0.267\ x\ (\frac{D}{d})^2\ x\ \left(\frac{L}{N}\right) x\ (LOG_{10}(P) - 1.06)\ x\ K_o \times K_{SG} \times K_T$$

Where,

T = blowdown time (minutes)

D = internal diameter of pipeline (inches)

d = internal diameter of blowdown piping (inches)

L = length of pipeline between valves (miles)

N = number of blowdown valves

P = shut-in pressure in pipeline (psia = PSIG + 14.73)

Log_{10} = logarithmic function to base 10

> **Note:** If length is given in feet, convert the length to miles by dividing by 5280 feet. Example: 528 feet ÷ 5280 feet ≈ 0.10 miles

4.4. **Blowdown Valve Size**

4.4.1. The following parameters are needed to determine the blowdown valve and piping size.

4.4.1.1. Internal diameter of the pipeline.

4.4.1.2. Amount of time desired to blow down the pipeline.

4.4.1.3. Shut-in pressure of the pipeline.

4.4.1.4. Length of pipeline segment to be blown down.

4.5. **Solving For Blowdown Piping Diameter**

4.5.1. The equation referenced in **Section 4.3** is again used to determine the blowdown piping size. Solving for the blowdown piping diameter, *d* (in), the equation derived is:

$$d = \mathrm{D} \times \sqrt{\left(\frac{0.267}{t}\right) \times \left(\frac{L}{N}\right) \times (Log_{10}(P) - 1.06) \times K_o \times K_{sg} \times K_T}$$

Where,

d = internal diameter of blowdown piping (inches)

D = internal diameter of pipeline (inches)

N = number of blowdown valves

T = blowdown time (minutes)

L = length of pipeline between valves (miles)

P = shut-in pressure in pipeline (psia = PSIG + 14.73)

Log10 = logarithmic function to base 10

Note: If length is given in feet, convert the length to miles by dividing by 5280 feet. Example: 528 feet ÷ 5280 feet ≈ 0.10 mile

4.6. Gas Volume Vented to Atmosphere

4.6.1. To determine the estimated amount of gas vented to atmosphere for controlled (shut in) blowdown valve applications, the following are applied.

$$V_2 = V_P \times \frac{(T_{standard} + 460)}{P_{atm}} \left(\frac{P}{Z\ x\ (T + 460)} \right)$$

Or

$$V_2 = 28.8 \times L \times D^2 \times \frac{(60 + 460)}{14.73} \left(\frac{P}{Z \times (T + 460)} \right)$$

Where,

V_2 = volume of gas vented to atmosphere (cu ft)

V_P = volume of pipeline segment to be blowdown = 28.8*L*D² (cu ft)

D = internal diameter of pipeline (inches)

L = length of pipeline between valves (miles)

Z = natural gas compressibility factor (see Table A in Appendix D)

P = shut-in pressure in pipeline (psia = PSIG + 14.73)

T = shut-in temperature before blowdown (F)

Note: When calculating volume remember that 10 MCF = 10,000 CF or 10 MSCF = 10,000 SCF. For emissions reporting purposes, standard conditions (60°F Temperature) shall be used to calculate the volume of gas vented to atmosphere. Units for reporting shall be in MSCF.

4.6.2. As required in Form 7011, *Blowdown Emission Reduction Plan* and Form 3466, *Reporting of Gas Blown to Atmosphere* the projected and/or calculated actual volume of gas blown to atmosphere must be submitted and/or reported by **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations.**

4.6.3. For blowdown operations that will result in a gas loss of 10 MSCF or more before any methane emissions reductions, use Appendices A, B or C to determine if Form 7011, *Blowdown Emission Reduction Plan* and Form 3466, *Reporting of Gas Blown to Atmosphere* are required.

4.6.3.1. Appendices A, B and C show the footage of pipe required for a volume loss of 10 MSCF. To use the Appendices, select the graph corresponding to the shut-in pressure, i.e.,≤ 100 PSIG, 100-1000 PSIG, or >1000 PSIG. In the selected graph, move along the horizontal axis until the shut-in pressure is reached. Proceed vertically to the curve representing the closest inside diameter of the shut-in pipeline. Read the length of the pipe. This is the estimated footage of pipe required for a volume loss of 10 MSCF.

4.6.3.2. If the actual footage of blowdown pipe is greater than this amount, complete Form 7011, *Blowdown Emission Reduction Plan* and Form 3466, *Reporting of Gas Blown to Atmosphere.*

Note:	A full calculation using the given equations is required for any footage of pipe with diameters greater than 16-inches to determine if the volume loss exceeds 10 MSCF.

4.6.4. The volume of gas saved due to a blowdown reduction method or approach must also be submitted and reported by **Transmission Operations, Construction Operations, Pipeline Integrity, Storage Operations,** or **Distribution Operations**. The volume of gas saved is the difference between the estimated volume at the operating pressure or OP before the blowdown of the line and the estimated volume of gas at the start of the event after a blowdown reduction was made.

4.6.4.1. To determine the estimated amount of gas saved due to a blowdown reduction for controlled (shut-in) blowdown valve applications, the following are applied:

$$V_{Saved} = V_1 - V_2$$

$$V_1 = V_P \times \frac{(60+460)}{14.7}\left(\frac{P_1}{Z \times (T+460)}\right)$$

$$V_2 = V_P \times \frac{(60+460)}{14.7}\left(\frac{P_2}{Z \times (T+460)}\right)$$

Where,

V_{Saved} = volume of gas saved due to blowdown reduction (cu ft)

V_P = volume of pipeline = 28.8*L*D² (cu ft)

V_1 = volume of gas in pipe before pressure reduction (cu ft)

V_2 = volume of gas in pipe after pressure reduction (cu ft)

D = internal diameter of pipeline (inches)

L = length of pipeline between valves (miles)

Z = natural gas compressibility factor (see Table A)

P_1 = shut-in pressure in pipeline before reduction (psia = PSIG + 14.73)

P_2 = shut-in pressure in pipeline after reduction (psia = PSIG + 14.73)

T = shut-in temperature before blowdown (F)

Note:	When calculating volume remember that 10 MCF = 10,000 CF or 10 MSCF = 10,000 SCF. For emissions reporting purposes, standard conditions (60°F Temperature) shall be used to calculate the volume of gas saved. Units for reporting shall be in MSCF.

4.7. Gas Volume Calculator for Blowdowns

4.7.1. To assist in the calculations of gas volume vented into the atmosphere a calculator was created to serve as a tool. This calculator is not required to use, but it's meant to aid. This calculator is automated and linked toForm 3466, *Reporting of Gas Blown to Atmosphere* to assist in the gathering of required information needed to submit **Form #3466**, *Reporting of Gas Blown to Atmosphere*. Please note the following:

4.7.1.1. This calculator is to serve as a tool only, not a requirement.

4.7.1.2. Form 3466, *Reporting of Gas Blown to Atmosphere* & Form 7011, *Blowdown Emission Reduction Plan* are still required to be submitted if the project meets the requirements for submittal.

4.7.1.3. This calculator determines the estimated amount of gas vented to atmosphere, estimated volume of gas saved, time required to blowdown, determines if the Form 3466, *Reporting of Gas Blown to Atmosphere* is required, and provides a potential blowdown cost.

Gas Volume
Calculator for Blowc

5. EXCEPTION PROCEDURE(See GS 182.0004, *Exception Procedure for Company Operations Standards*)

5.1. An exception to this standard shall be considered only after all practicable solutions have been exhausted. All proposed exceptions to this standard must take safety issues into primary consideration and must comply with all relevant governing codes before approval of any proposed exception may be granted.

5.2. An exception to this standard shall be permitted only if GS 182.0004, *Exception Procedure for Company Operations Standards*, is followed, and approval is granted by those required by GS 182.0004.

6. RECORDS

6.1. Follow instructions as required in Form 7011, *Blowdown Emission Reduction Plan,* and Form 3466, *Reporting of Gas Blown to Atmosphere.*

7. APPENDICES

7.1. APPENDIX A – Footage of Pipe Required for Volume Loss of 10 MSCF: Shut-In Pressure of Less Than or Equal to 100 PSIG

7.2. APPENDIX B - Footage of Pipe Required of Volume Loss of 10 MSCF: Shut-In Pressure of More Than 100 PSIG

7.3. APPENDIX C - Footage of Pipe Required of Volume Loss of 10 MSCF: Shut-In Pressure Greater Than 1000 PSIG

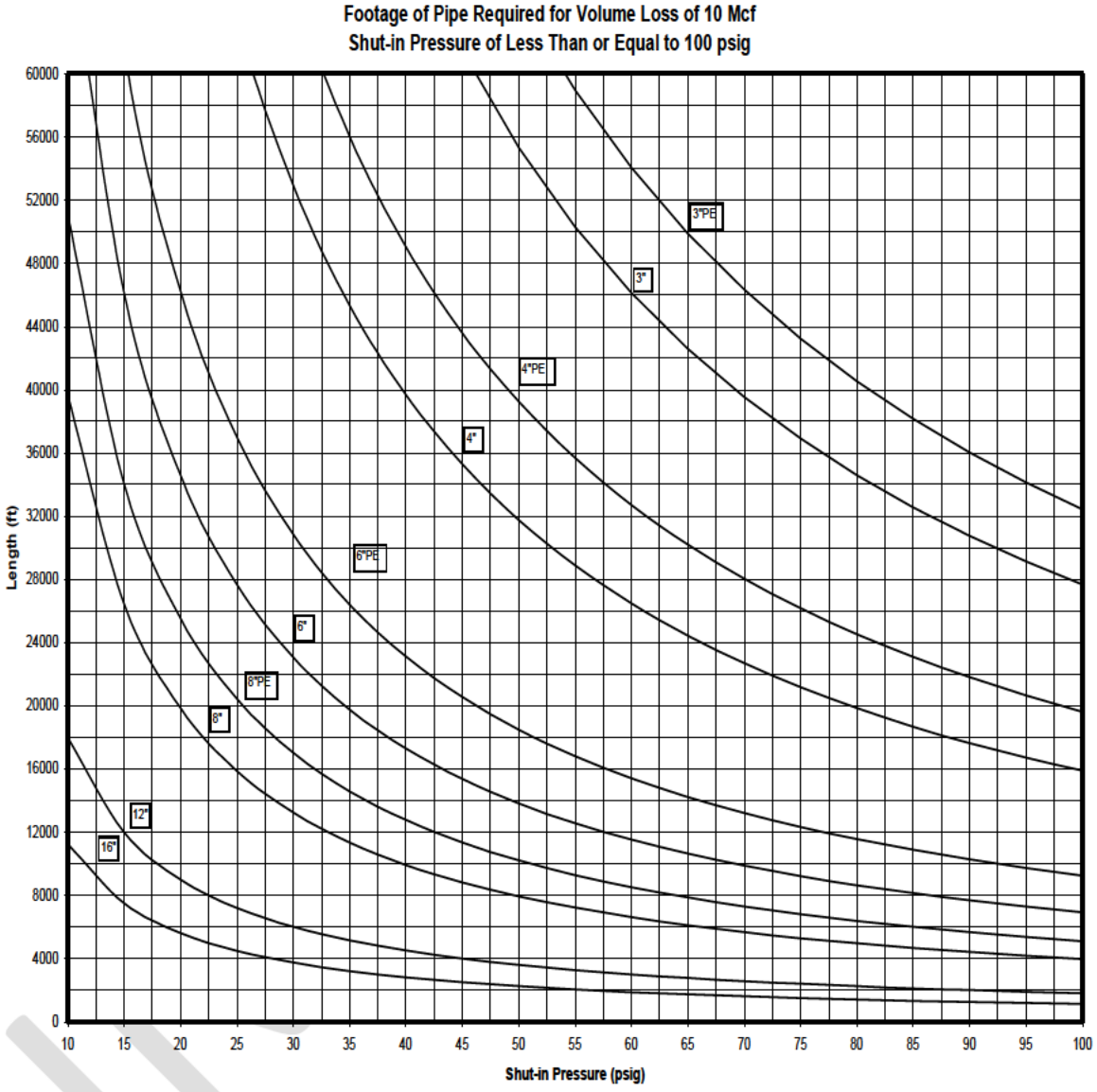
7.4. APPENDIX D – Natural Gas Compressibility Factors

8. PROTECTED SECTIONS AND WORDING

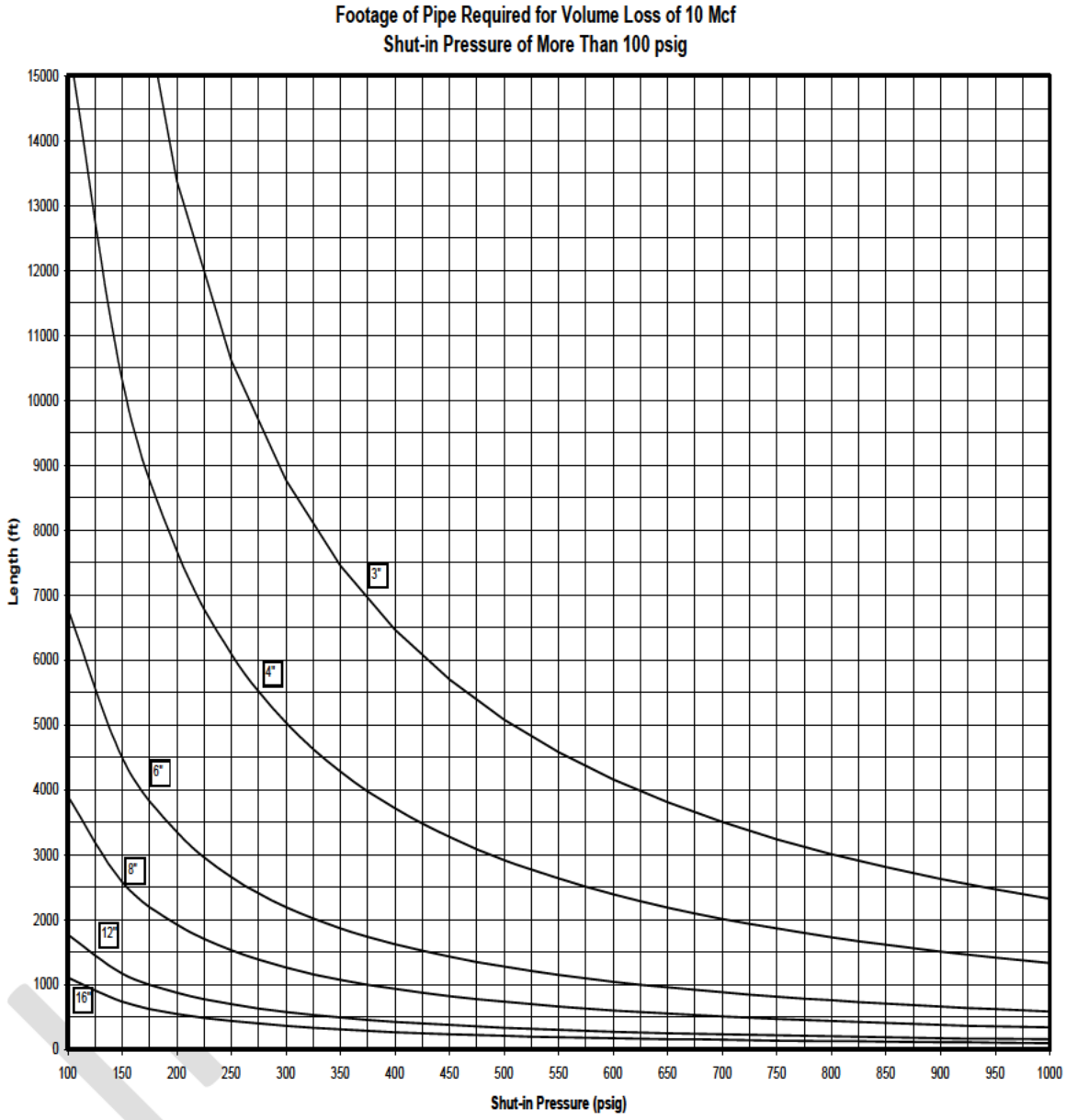
The following sections and wording in this document cannot be altered or deleted without prior approval from Pipeline Safety & Compliance and Legal:

Section	Protected Wording (Underlined ONLY)	Justification	Date Wording Added
Not Applicable			

APPENDIX A

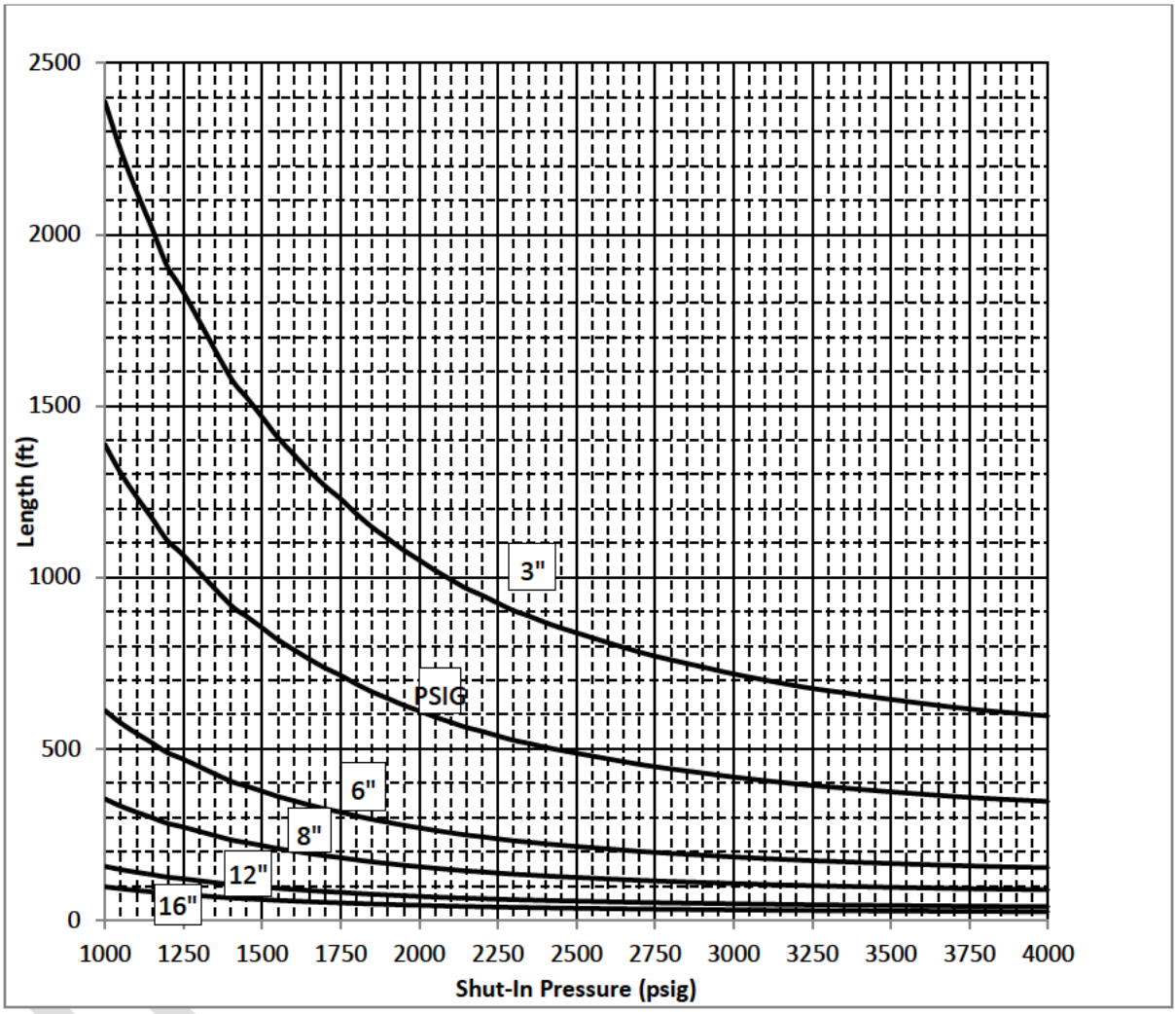


APPENDIX B



APPENDIX C

Footage of Pipe Required for Volume Loss of 10 MSCF
Shut-in Pressure Greater than 1000 PSIG (T=60°F)



APPENDIX D - Table A
Natural Gas Compressibility Factors - (Gas Temperature at 60° F)

Pressure (PSIG)	Compressibility Factor	Pressure (PSIG)	Compressibility Factor	Pressure (PSIG)	Compressibility Factor
0	0.9971	1250	0.7967	2750	0.7300
50	0.9875	1400	0.7799	2900	0.7378
100	0.9780	1450	0.7748	3000	0.7447
150	0.9686	1500	0.7698	3050	0.7487
200	0.9592	1550	0.7651	3100	0.7530
250	0.9500	1600	0.7606	3150	0.7577
300	0.9410	1650	0.7563	3200	0.7628
350	0.9320	1700	0.7523	3250	0.7682
400	0.9232	1750	0.7485	3300	0.7740
450	0.9145	1800	0.7450	3350	0.7801
500	0.9059	1850	0.7417	3400	0.7867
550	0.8975	1900	0.7387	3450	0.7936
600	0.8892	1950	0.7359	3500	0.8009
650	0.8811	2000	0.7334	3550	0.8087
700	0.8731	2050	0.7311	3600	0.8168
750	0.8653	2100	0.7291	3650	0.8253
800	0.8577	2150	0.7274	3700	0.8342
850	0.8502	2200	0.7260	3750	0.8435
900	0.8429	2250	0.7249	3800	0.8533
950	0.8357	2300	0.7240	3850	0.8634
1000	0.8287	2350	0.7235	3900	0.8740
1050	0.8220	2400	0.7232	3950	0.8850
1100	0.8154	2450	0.7233	4000	0.8965
1150	0.8090	2500	0.7236	4050	0.9084
1200	0.8028	2650	0.7265	4100	0.9207

* For pressure values not listed, use the compressibility factor of the closest pressure.

** The compressibility factors in this table were generated from a curved fit equation derived from the Gas Processors Suppliers Association (GPSA) Engineering Data Book's (2013) graph of natural gas compressibility factors (pg. 23-13). For an estimated compressibility factor value see formula below

$\mathbf{Z} = 0.0000000000561695578 \times \mathbf{P}^3 + 0.0000001941017389990 \times \mathbf{P}^2 - 0.0001942451475502070 0 \times \mathbf{P} + 1$

Psia (**P**) = PSIG + 14.73

*** For gas temperatures other than 60°F contact **Gas Engineering** - **Pipeline Engineering** for compressibility factors.

**** For Specific Gravities other than 0.6 contact **Gas Engineering** - **Pipeline Engineering** for compressibility factors.

NOTE: Do not alter or add any content from this page down; the following content is automatically generated.
Brief: 5 Year Review. Added section 1.4 to include criteria and add the requirement to complete Form 7011 "Blowdown Emission Reduction Plan" where volume loss is to be estimated prior to a blowdown. Section 1.5 was added and is a continuation of section 1.4, its to inform of what is to be determined and documented in Form 7011. Section 1.6 was added to inform about Form 3466 "Reporting of Gas Blown to Atmosphere" which is to be completed upon completion of a blowdown. Section 3.2 was added to add the definition of "Blowdown Reduction", and it includes examples to reference. Reformatted and moved sections 4, 5, 6, 7, 8, 9, and 10 into subsections within newly created section 4 "Procedure". Revised and made changes to section 4 including parameter additions in 4.1 and adding correction factors to the formulas in sections 4.3 and 4.5. Section 4.6.1 formulas were updated to provide estimated amount of volume of gas vented to the atmosphere. Section 4.6.2 was revised to reference both form 3466 and 7011. Section 4.6.3 verbiage was revised to include form 3466 and Form 7011 instructions on when to complete them. Section 4.6.4 was added to include the calculations used to determine the volume of gas saved due to a blowdown reduction method or approach. In addition, the need to report volume as required in Form 7011 and 3466. In Section 4.7 a Gas Volume Calculator for Blowdowns was added. Section 6 was revised to add Form 7011. Section 7 was created to add appendices section. Table A in Appendices D was revised to update values and to provide guidance for specific gravities not available. Editorial and format changes were made throughout the document. The latest Gas Standard Template was used.

Document Profile Summary	
Responsible Person:	Rodriguez Paz, Cristopher D
Published On:	4/1/2023
Last Full Review Completed On:	2/24/2023
Document Status:	Active
Doc Type:	STAND
Category (Prior FCD system only):	
If Merged, Merged To Document Number:	
Utility:	SoCalGas
Department:	Gas Engineering
Number of Common Document (if applicable):	G8146
Confidential Sections:	
Contains OPQUAL Covered Task:	No
Part of SoCalGas O&M Plan:	No
Part of SDG&E O&M Plan:	No
Last O&M Review date:	
Writer:	Rodriguez Paz, Cristopher
O&M 49 CFR Codes & Impacted Sections of Document:	
Part of Non-O&M Parts 191-193 Plan:	No
Non-O&M 49 CFR Codes & Impacted Sections of Document:	
Part of Distribution IMP (DIMP):	No
Part of Transmission IMP (TIMP):	No
Part of Storage IMP (SIMP):	No
Impacts GO112F:	No
GO112F Codes & Impacted Sections of Document:	
Impacts GO58A:	No
GO58A Codes & Impacted Sections of	

Document:	
Impacts GO58B:	No
GO58B Codes & Impacted Sections of Document:	
Part of CA PUC:	No
CA PUC Codes & Impacted Sections of Document:	
Impacts New Business Construction:	No
Indices/Binders in Which Document is Filed:	DISTM, OEMSTOR, STOR, TPP
NOP Learning Module (LM) Training Code:	NOP00230