Methane Reductions from Pipeline Maintenance Activities

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U. S. Natural Gas Transmission Systems

• Transmission and Gathering Systems - approximately 325,000 miles of pipe \(^1\)
• Approximately 1,800 compressor stations \(^2\)
• Over 50,000 reciprocating compressor engines are operated within the U.S. \(^2\)

\(^1\) U.S. Department of Transportation, Pipeline and Hazardous Materials Safety Administration
\(^2\) U.S. Environmental Protection Agency estimate
Methane Emissions - Natural Gas Sector

Gas Transmission Sector Reduction Technologies Since 1993

Top Technologies Since 1993
Cumulative Sector Reductions = 232.8 Bcf

- Use fixed/portable compressors for pipeline pumpdown: 20%
- Di&M at compressor stations: 17%
- Install vapor recovery units on pipeline liquid/condensate tanks: 16%
- Use of turbines at compressor stations: 13%
- Replace wet compressor seals with dry seals: 13%
- Di&M at surface facilities: 10%
- Use composite wrap repair: 6%
- Other: 5%

Reference: EPA Natural Gas STAR Program Web Page
Methane Emission Reduction Methodologies

• Under the Natural Gas STAR Program, EPA identifies 10 available reduction methodologies
  – Pipeline Pump-Down: lower pipeline pressure prior to maintenance activities
    • Use fixed or portable compressors
  – Install Composite Wrap for Pipeline Repairs
Pipeline Pump-Down

• Goal: Minimize natural gas blow downs associated with pipeline maintenance activities
• Pipeline Pressure Reduction Methodologies include:
  – Reduce pipeline pressure using downstream take-away capacity
    • Applicable for non-urgent, scheduled maintenance activities
  – Use fixed compression, typically existing compressor stations
  – Use portable compression, incremental cost for temporary compression
Pipeline Pump-Down Use

• Applicable Maintenance Activities
  – Pipeline Anomaly Repairs, if time allows
  – Hydrostatic Testing
  – Pipeline segment abandonment
Pipeline Depressurization

1. Identify Pipeline Segment Needing Repair
   - Pipeline
   - Compressor Block Valve Open
   - Compressor Block Valve Open
   - Pipeline

2. Depressurize Segment by 50% Using In-line Pipeline Compressor
   - Pipeline
   - Compressor Block Valve Closed
   - Compressor Block Valve Open
   - Pipeline

3. Depressurize Segment Further 90% Using Portable Compressor In Sequence With an In-line Compressor
   - Pipeline
   - Compressor Block Valve Closed
   - Compressor Block Valve Closed
   - Pipeline

Legend:
- Normal pipeline pressure
- Pipeline with pressure reduced 50%
- Pipeline with pressure reduced 90%

Portable Compressor
Install Composite Wrap for Pipeline Repairs

• Goal: Minimize natural gas blow downs associated with pipeline maintenance activities

• Mechanical sleeves or composite wrap repair methods

• Benefits:
  – Repairs made without taking pipeline out of service
  – Operating pressure reduction may be required, but no gas blow down required
Composite Wrap

• Types:
  – Clock Spring® - composed of glass fibers and polyester resin
  – Strong Back system – water activated, can be used on wet surfaces
  – Armor Plate® - variety of wrap systems for high/low pressure or temperature applications and underwater applications
  – PermaWrapTM – allows detection of previous wrap by inline inspection tools (e.g., smart pigs)
Composite Wrap

Clock Spring®

A Clock Spring® composite wrap consists of three parts:

1. A high-strength, unidirectional composite structure of glass fibers and a polymer base;

2. A fast curing, high-performance, two-part adhesive system; and

3. A high compressive-strength, load-transferring filler compound.
Repair Factors

• Determine whether suitable application
  – Defect type
    • Dent, gouge or corrosion
  – Defect Depth – % metal loss
  – Pipeline depth
  – Pipeline diameter and wall thickness
  – Pipe yield strength
  – Length of pipe wall loss or deformation
  – Defect axial length
Mechanical Sleeve or Composite Wrap Repair Evaluation

- Sleeve or Wrap Application is suitable
- Determine repair cost
- Compare to pipeline section replacement cost
- Estimate natural gas savings (volume and cost)
- Repair method based on engineering and economic evaluation
Factors for Determining Project/Repair Costs

• Labor cost
• Material costs
  – Sleeve or composite wrap
  – Replacement pipe
• Equipment cost
  – Backhoe, other equipment
  – Contractor
  – Inspection
  – Temporary/Rental compression
• Indirect Costs
  – Right-of-way damages
  – Permits
Estimating Natural Gas Savings

\[ V_{\text{natural gas}} = \frac{\pi \left( \frac{D}{2} \right)^2 L (P)}{1,000} \]

Where:

- \( V_{\text{Natural Gas}} \) = Volume of Natural Gas, mcf
- \( D \) = Inside diameter of pipe, feet
- \( L \) = Length of pipe, feet
- \( P \) = Pipeline Pressure, psia
Example: 10 mile section of 30 inch pipe

\[
v = \frac{3.1416 \left(\frac{30}{12} \text{ in/ft}\right)^2 \left(10 \text{ mi} \times 5,280 \text{ ft/mi}\right)}{1,000 \text{ cf/mcf}} \frac{(700 \text{ psi} + 14.73 \text{ psi})}{14.73 \text{ psi}}
\]

- D = 30 inch, nominal
- L = 10 miles
- P = 700 psi

- Natural Gas Savings = 12,576 mcf
Kinder Morgan’s Natural Gas Pipeline Operations

- Largest natural gas transporter and storage operator in US
  - Operates approximately 62,000 miles of natural gas pipelines
- Key Assets
  - Texas Intrastate Pipeline Group serving producers and customers in Texas
  - Tennessee Gas Pipeline serving markets from Texas to northeastern US markets (e.g., New York City and Boston)
  - Southern Natural Gas serving southeastern US markets (e.g., Atlanta)
  - Natural Gas Pipeline Company of America serving central and mid-western US markets (e.g., Chicago)
  - El Paso Natural Gas serving southwestern US markets (e.g., Phoenix, Tucson and California)
  - Colorado Interstate Gas, Wyoming Interstate Company and TransColorado Gas Transmission Company serving Rocky Mountain markets
  - Mohave Pipeline Company and the Ruby Pipeline serving California markets
Kinder Morgan’s Natural Gas STAR Program Experience

• Kinder Morgan’s natural gas pipeline companies have participated in EPA Natural Gas STAR program since 1993

• Since 1993, Kinder Morgan companies have achieved cumulative methane reductions of over 77.3 Bcf
  – Pipeline Pump-down and temporary compression: 23.8 Bcf
  – Mechanical sleeve or Composite wrap: 6.5 Bcf
Kinder Morgan Cumulative Methane Reductions (1993-2010): 77.3 Bcf
More Information

• Additional information regarding methane emission reduction technologies is available from EPA’s Natural Gas STAR Program Web Page:

  • [http://www.epa.gov/gasstar/](http://www.epa.gov/gasstar/)

• Technical Documents are available in Arabic, Chinese, Russian and Spanish