



Introduction to Gas Pipeline Design and Construction

Marco D. Boscardin, Ph.D., P.E.

Boscardin Consulting Engineers, Inc.

26 May 2015

Outline of Presentation

- ▶ I. Introduction
- ▶ II. Typical Gas Pipeline Design Considerations
- ▶ III. Typical Gas Pipeline Construction Methods
- ▶ IV. Potential Landowner Concerns
- ▶ V. Potential Impacts
- ▶ VI. Closing
- ▶ VII. Questions



Pipeline Conditions in Massachusetts



Potential Conditions Along A Pipeline Route in Massachusetts

- ▶ Areas of Clay, Glacial Till, Shallow Rock, Slopes
- ▶ Streams and Wetlands, including CT River Valley
- ▶ Roads and Railroads
- ▶ Conservation Lands
- ▶ Agricultural Lands
- ▶ Cultural Resources
- ▶ Cities, Towns, Rural Residences

Potential Issues for Landowner and Community



- ▶ Alignment Selection
- ▶ Safety
 - ▶ Explosion
 - ▶ Toxicity
- ▶ Impacts on Surrounding Land Use and Facilities
 - ▶ Future ROW use, Restored Soil Fertility, Routine Access
- ▶ Erosion Control, Noise, Dust, Vibration, Releases
 - ▶ Construction vs. O & M, Herbicides
- ▶ Crossing Sensitive Lands

Gas Pipeline Design Considerations



- ▶ Function - Transmission vs. Distribution
 - ▶ Transmission – Bulk Transport, Larger-Higher Pressure Pipes, Few Connections
 - ▶ Compressor Stations to Periodically Boost Pressure due to Friction Losses
 - ▶ Distribution – Delivery to Customers – Many Smaller Pipes/Connections – 5 to 100 psi
- ▶ Transmission Line : Typ. Size – 24-to-40-inch-diameter pipe; Pressure –to 1500 psi
 - ▶ 2 x Diameter: Can Deliver More than 4 x the Volume of Gas
 - ▶ Higher Pressure Compresses Gas So Can Transfer More
- ▶ Design Life (50 to 75 years) vs Actual (potentially much more)
- ▶ Loads – Soil, Water, Thermal, Surcharges, Seismic, Ground Stability
- ▶ Alignment Corridor Access Constraints

Design Considerations - a

▶ Ground, Environmental, Cultural, Societal Use

- ▶ Rock, Sand, vs. Clay and Ease of Construction
- ▶ Ecologically Sensitive Areas, Endangered Species, Cultural Lands
- ▶ Urban, Suburban, vs. Rural Lands
 - ▶ Class Location Based on Occupancy per Mile within 660 feet of the Pipe
 - ▶ High Consequence Area – Schools/Hospitals/Lifeline Facilities, Outside Assembly Areas

▶ Corrosion, Abrasion, Chemical & Electrical Attack

- ▶ Coatings – Outside & Inside; Cathodic Protection; Pipe Wall Thickness
- ▶ Depth of Burial Minimum 3 feet to Top of Pipe (220 CMR 109), Deeper Under Roads, In Agricultural Areas, and More Populated Areas

▶ Pipe Material

- ▶ Steel for Larger, Higher Pressure Lines (SMYS = 70,000 psi Grade X-70 Steel Strength)
- ▶ HDPE Could Be Used for Lower Pressure Lines (<100 psi Gas Pressure)

Location Class per 49 CFR 192

No. houses per mile	Class Location	Stress Level
10 or less	1	72%
10 to 46	2	60%
46 or more	3	50%
4-story buildings	4	40%

From: George W. White | Pipeline & Gas Journal [September 2012, Vol. 239 No. 9](#)

HIGH CONSEQUENCE AREA DEFINITION



- ▶ A Class 3 or Class 4 location.
- ▶ An area in a Class 1 or Class 2 location
 - ▶ where the potential impact radius is greater than 660 feet (220 yards) and the potential impact circle contains 20 or more buildings intended for human occupancy or an *identified site*.
- ▶ Areas Where Large Numbers of People Often Congregate
- ▶ Potential Impact Radius (PIR)
 - ▶ 930 feet for 36-inch pipe at 1400 psi

From PIPELINE INTEGRITY BASICS, Presented by Dr. John F. Kiefner, June 22, 2011

Design Considerations - b

- ▶ QA/QC (During Manufacturing, Construction Operation)
 - ▶ Standards
 - ▶ PHMSA, CFR, ASME, Welder Certification
 - ▶ Inspections
 - ▶ Visual, Smart Pigging
 - ▶ Testing
 - ▶ X-ray Welds, Hydrostatic Pressure Tests, Non-Destructive Testing
- ▶ Operation & Maintenance
 - ▶ Inspections, Patrols, Testing
- ▶ Risk

Gas Pipeline Construction Methods



- ▶ Conventional Trenched Construction on Land
 - ▶ Cut-and-Cover
 - ▶ For a 36-inch Pipe Expect at Least a 5-Foot wide Trench, Possibly more if sloped.
 - ▶ Trenching Machines
 - ▶ Typically 85-to- 100-foot-Wide Construction Easements, 50-foot Permanent ROW

Pipeline Construction Sequence



From the Federal
Energy Regulatory
Commission

Clearing ROW



From www.pipeliners-uk.com

Stringing Out Pipe



From Pacific Connector Gas Pipeline
(www.pacificconnectorgp.com)



From Plymouth HDD (2004)

Trench Excavation



From Pacific Connector Gas Pipeline
(www.pacificconnectorgp.com)



From Hamle
(www.hamleas.com)

Installing Pipe



From PBS Newshour
(www.pbs.org)



Image courtesy of Nabucco Gas Pipeline International GmbH

From Natural Gas Asia
(www.naturalgasasia.com)

Backfilling



From Pipelines International
(pipelinesinternational.com)

Restoration



From www.pipeliners-uk.com