Highway Crossings - Cased or Uncased?

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Office of Pipeline Safety
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PHMSA Mission

To ensure the operation of the Nation’s pipeline transportation system is:

- Safe
- Reliable
- Environmentally sound
Who is PHMSA?

Pipeline and Hazardous Materials Safety Administration (PHMSA)
PHMSA - OPS Regions

- Western Region
  - Lakewood
  - Kansas City

- Central Region
  - T&Q
  - Oklahoma City

- Southwest Region
  - Houston

- Southern Region
- Eastern Region
  - Trenton
  - HQ
  - Washington, D.C.
Where are pipelines located in the US? Everywhere.
# Pipeline System Components - 2011

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>Mileage</th>
<th>Total (%)</th>
<th>Operators</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hazardous Liquid</td>
<td>182,135</td>
<td>7</td>
<td>359</td>
<td>12</td>
</tr>
<tr>
<td>Gas Transmission</td>
<td>304,580</td>
<td>11</td>
<td>899</td>
<td>32</td>
</tr>
<tr>
<td>Gas Gathering</td>
<td>20,242</td>
<td>1</td>
<td>310</td>
<td>11</td>
</tr>
<tr>
<td>Gas Distribution</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(main)</td>
<td>2,113,511</td>
<td>81</td>
<td>1,284</td>
<td>45</td>
</tr>
<tr>
<td>(service)</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>1,232,173</td>
<td>47</td>
<td></td>
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<tr>
<td></td>
<td>881,338</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2,620,468</td>
<td>100</td>
<td>2,852</td>
<td>100</td>
</tr>
</tbody>
</table>
Pipeline Major Injuries (1986-2011)

Data source: DOT-PHMSA Incident data (as of Jan. 18, 2012)
Pipeline Fatalities
(1986-2011)

Data source: DOT-PHMSA Incident data (as of Jan. 18, 2012)

$y = 23.102e^{-0.019x}$
(1.9% decline/yr.)
All Incidents - Gas Transmission and Liquid Pipelines - 2002 to 2012

- All Other Causes
- Corrosion
- Excavation Damage
- Incorrect Operations
- Material/Weld/Equip. Failure
- Natural Force Damage
- Other Outside Forces
How are pipelines regulated?
Pipeline Regulations

- **Federal Regulations and Jurisdiction**
  - Natural Gas Pipelines – 49 CFR Part 192
  - Liquid Pipelines – 49 CFR Part 195
  - Interstate, crossing State boundaries

- **State Regulations and Jurisdiction**
  - States can have regulations that are more stringent than Federal Regulations for intrastate pipelines
  - Intrastate, contained within a State’s boundaries
Pipeline Regulations

- Reporting – Incidents and Annual Report
- Materials
- Design
- Construction
  - Welding
  - Coating
  - Cover and Backfill
  - Pressure Testing
- Operations
  - Integrity Management
Regulations for Cased/Uncased Crossings

- **Gas Pipeline - Design**
  - **Cased Crossing Design Factor**
    - Class 1 location – 0.72
    - Class 2 location – 0.60
    - Class 3 location – 0.50
    - Class 4 location – 0.40
  - **Uncased Crossing Design Factor**
    - Class 1 location – 0.60
    - Class 2 location – 0.50
    - Class 3 location – 0.50
    - Class 4 location – 0.40

- **Liquid Pipeline – Design**
  - Design safety factor - 0.72
  - withstand dynamic stresses from traffic loads
Regulations for Cased /Uncased Crossings

- **Coating** – external corrosion coating
- **Welding** – qualified procedures and welders
- **Depth of Cover** – min. cover at crossing
- **Pressure Testing** –
  - 1.25 to 1.5 times maximum operating pressure
- **Pipeline Markers** – at highway crossings
- **Periodic Patrols**
- **Corrosion Control** – periodic evaluations
- **Integrity Management** – periodic evaluations
Cased Crossings

- Have an outer casing to protect the pipeline from excavation damage and traffic loads;
- Able to pull pipe out of casing;
- Outer casing will not protect public from a release from a leak or failure of the pipeline; and
- Annulus between the casing and pipeline can be a source of electrical shorts due to damage to the coating, casing, and casing end seals, which may cause corrosion to the pipeline.
Casing – Pipe with Spacers
Casing

Casing end location with spacer removed for inspection
Cased Crossing

Failed casing end seal
Partial Electrolytic (Water) Contact

Figure 2: Isolated casing. Annulus partially full of electrolyte. Holidays on bottom of pipe submerged receive CP current.
Example of cased pipeline with corrosion from electrolyte and damaged external coating

The damaged coating by the spacer rings provided a location for the corrosion to start.
Cased Crossing

Removing coating for inspections
Uncased Crossings

- Have additional wall thickness in the pipe design
- No casing end seals to fail
  - That will let water and mud into the casing when it fails
- No casing and spacers for the pipeline to short against
  - Metallic
  - Electrolytic (water)
- Horizontally Directional Drilled (HDD) or Bored
  - HDD for longer crossings; bored for short crossings
  - 4-lane and interstate highways with wide ROWs
  - Use HDD best practices – State and Industry
Uncased Crossings

[Images of uncased crossings and construction site]
Uncased Crossings

- Girth Weld Nondestructive Examination (NDE)
  - 100% NDE of Girth Welds in Crossing Right-of-Way

- Coatings
  - Main coating for corrosion control
  - Abrasive resistant coating over the corrosion coating

- Crossing Angle
  - Between 90 degrees to 45 degrees
  - HDD methods can be used to mitigate location issues such as pipe alignment, backfill material and depth of cover
Uncased Crossings

- **Hydrostatic Pressure Test**
  - Hydrotest to be at min. of 1.25 to 1.5 X MAOP and for 8 hours
  - Perform hydrotest
    - prior to (based upon risk and design factor/location)
    - after installation
  - Pre-installation pressures (+25 to 50 psi) over post-installation test pressure
  - Post-installation test
Uncased Crossings

- **Other**
  - **HDD or Boring Technique**
    - ✓ Grout slurry backfill within bore ID, where needed
  - **Cathodic Protection (CP)**
    - ✓ Able to maintain uninterrupted CP current along the pipe in crossing
  - **Pipeline Markers at Crossing**
  - **Depth of Cover at Crossing and Ditches**
    - ✓ Able to HDD highway crossing at greater depths to stay out of road fill material, minimize loads, and for 3rd Party Damage Avoidance
Cased or Uncased Highway X-ings

- Pipeline Codes both Federal and State regulations have provisions for both cased and uncased crossings to be used;
- Operational, terrain, and environmental situations are considerations in selecting installation type;
- Operational maintenance and the integrity of uncased crossings are better maintained due to not having the casing around the pipeline.
Cased or Uncased Highway X-ings

- Both highway crossings methods have proved to be safe when properly designed, constructed, and maintained;

- Uncased pipeline highway crossings on new installations are preferred, where feasible
  - No cathodic protection shielding issues
  - Heavier wall thickness (stronger) pipe required
    - Design should account for combined stresses (such as internal pressure, earth, live, and cyclic stresses, see API 1102 – Steel Pipelines Crossing Railroads and Highways)
  - Maintenance
PHMSA – links

- PHMSA Pipeline Technical Resources
  - [http://primis.phmsa.dot.gov/ptr.htm](http://primis.phmsa.dot.gov/ptr.htm)
  - Alternative MAOP
  - Cased Crossings & Guided Wave Ultrasonics (GWUT)
  - Class Location Special Permits
  - Control Room Management (CRM)
  - Gas Distribution Integrity Management Program (DIMP)
  - Gas Transmission Integrity Management (GT IM)
  - Hazardous Liquid Integrity Management (HL IM)
  - High Volume Excess Flow Valves (EFV)
  - Low Strength Pipe
  - Operator Qualification (OQ)
  - Pipeline Construction
  - Research & Development (R&D)
  - Public Meetings
Thank you

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