Agenda

1. Introduction to Gas and Oil Pipelines
   - Benefits, Network, Characteristics, Challenges, Regulatory Framework

2. Rights-of-Way
   - Specification
   - Acquisition
   - Development
   - Maintenance

3. Pipeline Integrity Management (IM)
   - IM Principles
   - Gas IM
   - Liquid IM

4. Pipeline Economics
Agenda

1. Introduction to Oil and Gas Pipelines
   - Benefits, Network, Characteristics, Challenges, Regulatory Framework
Oil Benefits

Energy
- Heating
  - Home heating oil
  - Propane
- Fuels
  - Automotive
  - Aviation
  - Railroads
  - Ships and barges
  - Power plants
  - Military bases

Raw materials
- Pharmaceuticals
- Plastics
- Cosmetics
- Fertilizers
- Construction materials
What Oil Pipelines Do

Transport flammable, hazardous, useful products to customers under strict federal and state requirements through towns, cities, neighborhoods, and cross country where people live, work and play.

We MUST do it safely and reliably
Vision Of Oil Pipeline Industry

- Conducts operations safely and with respect for the environment;
- Respects the privilege to operate granted to it by the public; and
- Provides reliable transportation of the crude oil and refined products upon which America and all Americans rely.
Petroleum Industry
The National Oil Pipeline Network

165,000 miles national transmission network

- Crude oil to refineries
- Refined products to end users

Volumes per year

- 1.8 trillion barrel miles refined products
- 1.6 trillion barrel miles crude oil
- 0.5 trillion barrel miles HVLs
Selected Crude Oil Trunkline Systems

- For Canadian Crude
- For Other Imports
- From a Domestic Origin
= Refining centers; capacity shown in million barrels per day
Oil Pipeline Characteristics

- Oil Pipelines transport 2/3 of crude oil, refined products, refinery blendstocks, LPG’s moved in U.S.
- Oil pipelines carry multiple products
- Oil pipelines do not own the products
- Customers are producers, refiners, major end-users – generally not consumers
- Alternative unregulated modes compete with oil pipeline transportation (e.g. barges, rail, trucks, local refineries)
Challenges to Oil Pipeline Industry

- Need to grow and realign industry assets (e.g. Alberta oil sands development, products demand increases in Southwest.)
- Significant new expenditures
  - Capacity expansion/realignment
  - Integrity management costs (>1 billion over next 5 years industry-wide)
  - Ultra Low Sulfur Diesel investment (approximately $230 million industry-wide)
- Public confidence in safe, environmentally responsible operations.
Natural Gas Benefits

Energy
- Residential
  - Heating
  - Cooking
- Commercial
  - Heating
  - Cooking
- Industry
  - Heating
  - Processing
- Electric Generation
- Transportation

Raw materials
- Fertilizer
- Plastics
- Chemicals

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NATURAL GAS USE
- Electric Power 26.4%
- Commercial 13.9%
- Residential 21.6%
- Industrial 30.3%
- Pipeline Fuel 2.6%
- Oil & Gas Industry Operations 5.0%
- Vehicle Fuel 0.1%
What Natural Gas Pipelines Do

Transport flammable natural gas to customers under strict federal and state requirements through towns, cities, neighborhoods, and cross country where people live, work and play.

We MUST do it safely and reliably
Vision Of Natural Gas Pipeline Industry

- Conducts operations safely and with respect for the environment;
- Respects the privilege to operate granted to it by the public need and necessity; and
- Provides reliable transportation of the natural gas upon which America and all Americans rely.
The Natural Gas Industry

Marketers

Producers
- Majors
- Independents

Gathering

Storage

Commercial

Residential

Industrial & Utilities

272,500 Gas Wells

30 Major Interstate Pipelines

1200 Distributors

AGA
AOPL
API
INGAA

Association of Oil Pipe Lines
Gas supply costs vary, but price set by market
The Natural Gas Pipeline Network

- 294,280 miles onshore gas transmission pipelines
- 6,637 miles offshore gas transmission pipelines
- 20,215 miles gas gathering pipelines
- 1,171,746 miles gas distribution mains
- 63,540,697 natural gas services

Gas Volume Consumed per Year
- 21,652 Trillion Cubic Feet
Interstate Natural Gas Pipelines

2007 Interstate Natural Gas Pipeline System
Natural Gas Pipeline Characteristics

- Natural gas transmission pipelines transport 99% of natural gas moved in the U.S.
- Natural gas pipelines carry one product
- Interstate natural gas pipelines do not own the product
- Intrastate natural gas pipelines may own some of the product transported
- Transportation customers are producers, LDCs, marketers and major end-users
- Interstate transportation rates are regulated by FERC
- Intrastate transportation rates are regulated by State PUC
Challenges to Natural Gas Pipeline Industry

- Need to grow and realign industry assets (e.g. Rocky Mountain, LNG, Alaska, Unconventional Gas) while expanding to new electric generation markets

- Significant new expenditures
  - Capacity expansion/realignment (7,200 miles interstate gas pipeline planned in near future)
  - Integrity management costs (>$5 billion over next 5 years industry-wide)

- Public confidence in safe, environmentally responsible operations.
Regulatory Jurisdiction for New Pipelines

- **Interstate natural gas**
  - FERC authority under the Natural Gas Act

- **Intrastate natural gas**
  - State jurisdiction for routing and public need determination

- **Liquid pipelines**
  - State jurisdiction for routing and public need determination

- **Pipeline and Hazardous Material Administration (PHMSA) (All of the above pipelines)**
Interstate Natural Gas – FERC Authority

Siting (NGA) (NEPA)

- Federal Energy Regulatory Commission (FERC)
  - Corp of Engineers
  - Bureau Land Management
  - Fish and Wildlife
  - Historic Preservation
  - Environmental Protection Agency
  - States
  - Local
State-regulated Pipeline Approvals

- **State programs may require one or more of:**
  - Certificate of Need from state public utility commission -or-
    Statutory designation of public need for utilities
  - Routing Permit - Comprehensive review of route alternatives
  - State environmental assessment and permitting

- **Federal permitting still applies**
  - Environmental must comply with National Environmental Policy Act
    - U.S. Army Corps of Engineers: jurisdictional waters
    - Fish & Wildlife, etc.
  - Federal landowner- land access for pipeline
2. Rights-of-Way

- Specification
- Acquisition
- Development
- Maintenance
Agenda

2. Rights-of-Way
   - Specification
     - Special needs/provisions during construction
     - Needs for operations and maintenance
     - Emergency access
     - Economic regulator expectation for ROW width

Acquisition
Development
Maintenance
Permanent Pipeline Easement

- Facilitate Access for:
  - Operation
  - Inspection
  - Maintenance

- Identification of Pipeline Location
  - Company
  - Landowners
  - Excavators
Pipeline Company Needs

- **Operation**
  - Meter Reading
  - Liquid Removal
  - Valve operation

- **Inspection**
  - Encroachment
  - One Call Response
  - Erosion
  - Leak
  - Corrosion
  - Appurtances
  - Environmental

- **Maintenance**
  - Erosion Repair
  - Coating Repair
  - Pipe repair
  - Cathodic Protection System Modification
  - Pipeline Replacement
  - Hydrostatic Pressure Testing

- **Emergency Access**
  - Leak Repair
  - Rupture Repair
  - Staging Area
Other Stakeholder Needs

- Landowner
  - Easement

- Customers
  - Transportation

- Regulatory
  - Environment
  - Safety
  - Public Need and Necessity
Proposed width of right-of-way

- **Permanent right-of-way**
  - Varies depending on route density
  - Narrower ROW (< 50 feet) provides little buffer from development
  - Wider ROW (> 75 feet) provides buffer but width often questioned by landowner and regulators
  - Are there multiple pipelines in easement?
  - Typical goal is to strive for 25 feet from edge of easement/utility

- **Temporary Work Space**
  - Depends on size of pipeline
  - Deeper ditch requires soil space
  - Significant space is needed for 2-lanes of equipment
Temporary Work Space

- Additional construction “roadway”
  - Equipment
  - Top and sub soil storage
  - Pipe welding
  - Passing lane for moving equipment

- Additional room often needed at roads and river crossings
Example: Interstate Natural Gas Pipeline ROW Construction

Pipeline Operator Proposes the ROW Construction

- Standard Practices (Natural Gas Act)
  - Minimize Costs
  - Minimize Time

- Environmental Constraints (National Environmental Policy Act)
  - Department of Interior
  - Environmental Protection Agency
  - Corp of Engineer

- Safety
  - Public Safety
  - Personnel Safety
Example: Interstate Natural Gas Pipeline ROW Construction Specification

- Normal Construction
  - Temporary Right-of-Way Width Requirements for Pipeline Construction; INGAA Foundation 1999
  - FERC Approval

- Special needs during construction
  - Wetlands
  - Suburban
### TABLE 2

<table>
<thead>
<tr>
<th>Variable</th>
<th>Decrease Width</th>
<th>Increase Width</th>
<th>*Extra Work Space</th>
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<td>2. Design Considerations</td>
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<td>Pipe Diameter (Included in the Recommended Width)</td>
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<td>Pipe Depth (Included in the Recommended Width)</td>
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<td>3. Terrain</td>
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<td>Undulating Alignment Profile</td>
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<td>Alignment Grade</td>
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<tr>
<td>Side Slope Grade</td>
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<td>4. Soils and Rock</td>
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<td>Rock Disposition by Stockpiling</td>
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<td>Special Erosion Control Requirements</td>
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<td>5. Landowner Requirements</td>
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<td>Construction Through Narrow Corridors Bounded by</td>
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<td>Structures</td>
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<td>Timber Disposition by Stockpiling</td>
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<td>6. Construction Plans</td>
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<tr>
<td>Inadequate Temporary Access Roads</td>
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<td>Automatic Welding Method</td>
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<td>7. Special Construction Work Areas</td>
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<td>Foreign Structure</td>
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<td>Construction Through Wetlands</td>
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<td>8. Uncertainties</td>
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<td>Unknown Underground Structures-Frequency of Tile</td>
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<tr>
<td>Unexpected Inclement Weather</td>
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</tr>
</tbody>
</table>
Example: Wetlands Construction Techniques

- Reduced Temporary ROW Width
- Seasonal Construction
- Wooden Mats
- Horizontal Directional Drilling
Example: Residential Construction Technique

- Reduced ROW Widths
- Stove Piping
- Boring
- Spoil Relocation
- Sheeting
2. Rights-of-Way

Specification

- Acquisition
  - Selecting pipeline routes
  - Obtaining easements

Development
Maintenance
Factors for Assessing Route Alternatives

- First consideration is meeting the energy demand and market need
  - Pipeline must get from Point A to Point B

- System Alternatives
  - Can company’s existing system be optimized?
  - Are there other efficient modes of transportation?
  - What is optimum size of pipeline needed?

- Pipeline Routing Alternatives consider:
  - Constructability and minimizing distance
  - Existing utility corridors and routes
  - Population and development
  - Minimizing or mitigating affects on unique environmental areas
**Route conditions vary widely**

- Rural farming and need to protect agricultural production
- River crossings where temporary bridge and bank restoration needed
- Wetland crossings: narrower workspace and minimal equipment
- More developed areas with competing desires to minimize impact and provide “buffer”
Example: Selecting alternate pipeline routes
Example: Obtaining Right of Way

- **Type**
  - Below Grade Pipe
    - Easements
  - Above Grade Facilities
    - Fee Simple

- **Temporary Construction**

- **Permanent Easement**

- **ROW access**

- **ROW Damages**
  - Easement Conditions
Agenda

2. Rights-of-Way
   Specification
   Acquisition
   ▪ Development
     • Typical provisions of ROW/easement agreements
     • Encroachment prevention
   Maintenance
Provisions of typical ROW/easement agreements

- the right to construct, lay, maintain, operate, renew, alter, repair, remove, change the size of, and replace pipelines
- the right to clear all trees, undergrowth and other obstructions from the right of way
Definition of a Setback

- **Spacing between a Pipeline and Some Activity**
  - Buildings
  - Vegetation
  - Excavation
  - Explosive Charges
  - Wildlife Habitat
  - Vehicle Loading
  - Visual Impact

- **Today’s Definition is Public Safety**
Terminology

- Setback
- Temporary Construction Easement
- Permanent Pipeline Easement
- Temporary Construction Easement
- Setback
**ROW or near ROW Development**

- Try to work with developers early
- Incorporate ROW as green space
- Walkways & benches add to ambiance
- Stay in touch with homeowners associations
2. Rights-of-Way

Specification
Acquisition
Development

- **Maintenance**
  - Encroachment prevention
  - Control of vegetation
  - Desired state of ROW for patrolling
On ROW

- Not acceptable to have permanent structures, significant grade changes, large landscaping
- Need to be able to inspect, operate and maintain the pipeline safely & effectively
- A clearly defined corridor blending with surroundings helps neighbors, residents and excavators manage activities
ROW Clearing Enables:

- Aerial surveillance to detect threatening excavation activities
- Visual corridor to defend against unauthorized excavation and development
- Routine maintenance access
- Emergency response access

Safety is the paramount reason for ROW clearing
Control of Vegetation on ROW

- ROWs are cleared of vegetation that could impede appropriate viewing and inspection.
- ROWs are cleared and maintained only to the widths allowed in the easement, which range in size but are typically 30’ to 50’.
- Notifications to landowners typically completed prior to starting the actual clearing process.
- Periodic vegetation control measures include mechanical mowing and tree canopy trim removal.
- Tree canopy removal may extend to trees rooted outside of the ROW but have canopy that overhangs into the ROW.
- *Interstate natural gas pipelines subject to FERC certificate conditions*
Adjacent to ROW

- Generally no restrictions beyond ROW or easement
- Possible exceptions – Activities impacting the pipeline
  - Contouring or terracing
  - Blasting
- Work with operator to maintain safety
Agenda

3. Pipeline Integrity Management (IM)
   - IM Principles
   - Gas IM
   - Liquid IM
3. Pipeline Integrity Management (IM)
   - IM Principles
     - Threat Identification
     - Risk Characterization
     - Preventive and Mitigative Measures
Gas IM
Liquid IM
Industry Goals

- No deaths
- No injuries
- No releases to the environment
- No operating errors
- Reliable service to our shippers, customers and communities
- Full compliance with requirements
Serious Incidents (All Pipelines)

National All Pipeline Systems Serious Incidents 1987-2006

Source: PHMSA Significant Incidents Files Oct 19, 2007
Integrated Quality Control

Corrosion Control
Integrity Management
Safety
Environmental
Communications
Security
Emergency Response
Control Center
Regulatory Compliance
Operator Qualification

Compressor/Pump
Pipeline
Measurement
Storage

Design
Construct
Operate
Maintain
Pipeline Safety - Layers of Protection

- **Regulations**
  - OPS 49 CFR 192/5

- **Codes**
  - ASME B31.4/8

- **Standards**
  - NACE RP-0169 & RP-0502
  - API RP-1163

- **Practices**
  - Close Internal Survey
  - Direct Current Voltage Gradient
  - Hydrotesting
  - Inline Inspection

- **Programs**
  - ASME B31.8 S
  - Integrity Management Standard

- **External Corrosion Threat**
  - Continually producing the next layers

- **Research Development & Demonstration**
Layers of Protection

Company Audits

PHMS A Audits

Work
Risk Characterization

- Risk: A measure that combines both the likelihood of conditions or events producing an undesired outcome with the type and magnitude of the resultant consequences

- Risk to Public = Probability $\times$ Consequence
In evaluating the integrity of the line, the operator must integrate all available information, including at a minimum:

- the potential for excavation or outside force damage, considering potential new development along the line,
- information about the potential impacts of a release on the HCA (e.g., drinking water intake),
- data gathered from the integrity assessments required by this rule, and
- cathodic protection surveys, patrolling, and other maintenance and surveillance activities.
## Threat Identification (example: natural gas transmission)

### APPENDIX 1

<table>
<thead>
<tr>
<th>2002 to 2006 Onshore Gas Transmission Reportable Incident Data</th>
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<tbody>
<tr>
<td><strong>Cause</strong></td>
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<tr>
<td>-----------------------------</td>
</tr>
<tr>
<td>External Corrosion</td>
</tr>
<tr>
<td>Internal Corrosion</td>
</tr>
<tr>
<td>Earth Movement</td>
</tr>
<tr>
<td>Lightning</td>
</tr>
<tr>
<td>Heavy Rains/Floods</td>
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<tr>
<td>Temperature</td>
</tr>
<tr>
<td>High Winds</td>
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<tr>
<td>Operator/Excavation Damage</td>
</tr>
<tr>
<td>Third Party Excavation Damage</td>
</tr>
<tr>
<td>Fire/Explosion as Primary Cause</td>
</tr>
<tr>
<td>Car, Truck or other Vehicle</td>
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<tr>
<td>Rupture of Previously Damaged Pipe</td>
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<tr>
<td>Vandalism</td>
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<tr>
<td>Body of Pipe</td>
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<tr>
<td>Component</td>
</tr>
<tr>
<td>Joint</td>
</tr>
<tr>
<td>Butt</td>
</tr>
<tr>
<td>Fillet</td>
</tr>
<tr>
<td>Pipe Seam</td>
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<tr>
<td>Malfunction of Control/Relief Equipment</td>
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<tr>
<td>Threads Stripped, Broken Pipe Coupling</td>
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<tr>
<td>Ruptured or leaking Seal Pump Packing</td>
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<td>Incorrect Operations</td>
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<td>Miscellaneous</td>
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<td>Unknown</td>
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<td><strong>Total</strong></td>
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</table>
## Consequences of Hazardous Liquids Pipeline Releases

### Safety Consequences, Hazardous Liquids Pipelines

<table>
<thead>
<tr>
<th>Year</th>
<th>Public Fatalities</th>
<th>Industry Fatalities</th>
<th>Public Injuries</th>
<th>Industry Injuries</th>
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<tr>
<td>2002</td>
<td>0 0%</td>
<td>1 100%</td>
<td>0 0%</td>
<td>0 0%</td>
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<tr>
<td>2003</td>
<td>0 0%</td>
<td>0 0%</td>
<td>0 0%</td>
<td>5 100%</td>
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<tr>
<td>2004</td>
<td>5 100%</td>
<td>0 0%</td>
<td>15 93%</td>
<td>1 6%</td>
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<tr>
<td>2005</td>
<td>0 0%</td>
<td>2 100%</td>
<td>2 100%</td>
<td>0 0%</td>
</tr>
<tr>
<td>2006</td>
<td>0 0%</td>
<td>0 0%</td>
<td>2 100%</td>
<td>0 0%</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>5 62%</strong></td>
<td><strong>3 37%</strong></td>
<td><strong>19 76%</strong></td>
<td><strong>6 24%</strong></td>
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</table>

### Property Damages (Millions of 2006 dollars)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Property</th>
<th>Public Property [Reimbursed]</th>
<th>Industry Property</th>
<th>Product Lost</th>
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<tbody>
<tr>
<td>2002</td>
<td>$49.0</td>
<td>$37.4 76%</td>
<td>$9.7 19%</td>
<td>$1.9 3%</td>
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<td>2003</td>
<td>$53.4</td>
<td>$30.4 56%</td>
<td>$21.5 40%</td>
<td>$1.5 2%</td>
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<td>2004</td>
<td>$70.9</td>
<td>$20.2 28%</td>
<td>$48.5 68%</td>
<td>$2.3 3%</td>
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<td>2005</td>
<td>$123.9</td>
<td>$82.4 66%</td>
<td>$38.2 30%</td>
<td>$3.3 2%</td>
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<td>2006</td>
<td>$38.2</td>
<td>$12.4 32%</td>
<td>$21.8 57%</td>
<td>$4.0 10%</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>$335.4</strong></td>
<td><strong>$182.8 54%</strong></td>
<td><strong>$139.7 41%</strong></td>
<td><strong>$12.9 3%</strong></td>
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## Consequences of Natural Gas Transmission

### Pipeline Releases

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of Incidents</th>
<th>% Total Incidents</th>
<th>Fatalities</th>
<th>Injuries</th>
<th>Property Damage ($)</th>
<th>% of Property Damage</th>
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<tbody>
<tr>
<td><strong>CORROSION</strong></td>
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<td>VARIOUS</td>
<td>5</td>
<td>3.4%</td>
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<td>5</td>
<td>$1,430,680</td>
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<td>Sub Total</td>
<td>5</td>
<td>3.4%</td>
<td>12</td>
<td>5</td>
<td>$1,430,680</td>
<td>1.7%</td>
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<td><strong>EXCAVATION DAMAGE</strong></td>
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<td>OPERATOR EXCAVATION DAMAGE</td>
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<td>THIRD PARTY EXCAVATION DAMAGE</td>
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<td>VARIOUS</td>
<td>42</td>
<td>28.5%</td>
<td>12</td>
<td>51</td>
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<td>46.5%</td>
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<td>Sub Total</td>
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<td>34.6%</td>
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<td>56</td>
<td>$40,379,294</td>
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<td><strong>HUMAN ERROR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INCORRECT OPERATION</td>
<td>4</td>
<td>2.7%</td>
<td>0</td>
<td>4</td>
<td>$0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Sub Total</td>
<td>4</td>
<td>2.7%</td>
<td>0</td>
<td>4</td>
<td>$0</td>
<td>0.0%</td>
</tr>
<tr>
<td><strong>MATERIAL FAILURE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MALFUNCTION OF CONTROL/RELIEF EQUIPMENT</td>
<td>1</td>
<td>0.6%</td>
<td>0</td>
<td>2</td>
<td>$154</td>
<td>0.0%</td>
</tr>
<tr>
<td>Ruptured or leaking seal/pump pack</td>
<td>1</td>
<td>0.6%</td>
<td>0</td>
<td>1</td>
<td>$0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Threads stripped, broken pipe coupling</td>
<td>3</td>
<td>2.0%</td>
<td>0</td>
<td>3</td>
<td>$1,759,456</td>
<td>2.1%</td>
</tr>
<tr>
<td>VARIOUS</td>
<td>11</td>
<td>7.4%</td>
<td>1</td>
<td>12</td>
<td>$5,731,642</td>
<td>6.9%</td>
</tr>
<tr>
<td>Sub Total</td>
<td>16</td>
<td>10.6%</td>
<td>1</td>
<td>19</td>
<td>$7,490,252</td>
<td>9.0%</td>
</tr>
<tr>
<td><strong>NATURAL FORCE DAMAGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VARIOUS</td>
<td>2</td>
<td>1.3%</td>
<td>0</td>
<td>2</td>
<td>$7,540,406</td>
<td>9.0%</td>
</tr>
<tr>
<td>Sub Total</td>
<td>2</td>
<td>1.3%</td>
<td>0</td>
<td>2</td>
<td>$7,540,406</td>
<td>9.0%</td>
</tr>
<tr>
<td><strong>OTHER OUTSIDE FORCE DAMAGE</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Car, truck or other vehicle not related to excavation activity</td>
<td>4</td>
<td>2.7%</td>
<td>0</td>
<td>4</td>
<td>$123,286</td>
<td>0.1%</td>
</tr>
<tr>
<td>Sub Total</td>
<td>4</td>
<td>2.7%</td>
<td>0</td>
<td>4</td>
<td>$123,286</td>
<td>0.1%</td>
</tr>
<tr>
<td><strong>ALL OTHER CAUSES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MISCELLANEOUS</td>
<td>1</td>
<td>0.6%</td>
<td>0</td>
<td>1</td>
<td>$3,351</td>
<td>0.0%</td>
</tr>
<tr>
<td>UNKNOWN</td>
<td>2</td>
<td>1.3%</td>
<td>0</td>
<td>2</td>
<td>$1,507,925</td>
<td>1.5%</td>
</tr>
<tr>
<td>VARIOUS</td>
<td>57</td>
<td>38.7%</td>
<td>7</td>
<td>97</td>
<td>$23,627,434</td>
<td>28.4%</td>
</tr>
<tr>
<td>Sub Total</td>
<td>60</td>
<td>46.8%</td>
<td>7</td>
<td>100</td>
<td>$24,938,710</td>
<td>30.0%</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>142</td>
<td>96.6%</td>
<td>37</td>
<td>189</td>
<td>$81,910,708</td>
<td>98.6%</td>
</tr>
</tbody>
</table>
The results of the likelihood assessment also provide the operator with information on the significance of different pipeline threats at different locations, allowing them to carry out actions that reduce the likelihood of a pipeline failure. For example, an operator may choose to conduct internal inspections on those pipeline sections that are shown to be most susceptible to corrosion, to identify where corrosion might be occurring, and to repair any damage before the pipe fails.
The results of the consequence assessment provide the operator with information on the significance of consequences of accidents at different locations, so that operators can carry out steps to reduce or eliminate those consequences. For example, an operator may place specialized emergency response equipment at an environmentally sensitive site to allow for quick response should a pipeline release occur.
**Risk Determination**

- The final step in risk assessment for a pipeline is to use the results of the likelihood and consequence assessments to determine the overall risk at each pipeline location. This allows the operator to ensure that sections identified as having the highest risk are assigned top priority for actions that will reduce the likelihood of a release, reduce its potential consequences, or both.
Operators must conduct risk analyses for the line segments that could affect HCAs. These analyses should identify and evaluate the need for additional preventive and mitigative actions to protect HCAs. Such measures might include:

- damage prevention best practices,
- enhanced cathodic protection monitoring,
- reduced inspection intervals,
- enhanced training,
- conducting drills with local emergency responders, and
- other management controls
3. Pipeline Integrity Management (IM)

IM Principles

- Gas IM
  - Design Factors based on Class Location
  - HCA Definitions, including Identified Sites
  - Integrity Assessments

Liquid IM
Pictorial of a High Consequence Area for Natural Gas Overlaid on The Present Class Location System

Class 3

Houses

30” Pipeline 720 psig

660 ft

HCA

Source: 2000 INGAA Proposal
IMP = Manage Time Dependent Effects

Manage Time Independent Effects
- Excavation Damage Prevention Understanding
  - 1st Party
  - 2nd Party
  - 3rd Party
- One Call Programs
- Common Ground Alliance (CGA)
- Excavation Damage Prevention Initiative (EDPI)
- Pipeline Easement Management
- Local Government Practices
**Integrity Assessments**  
*(example: natural gas transmission pipelines)*

### Table 3

**2004 – 2006 PHMSA Integrity Management Metrics**

<table>
<thead>
<tr>
<th>PHMSA METRIC Onshore &amp; Offshore Pipelines</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Onshore &amp; Offshore Gas Transmission Miles</td>
<td>296,740</td>
<td>295,613</td>
<td>288,765</td>
</tr>
<tr>
<td>Total Miles Inspected</td>
<td>30,398</td>
<td>19,669</td>
<td>19,765</td>
</tr>
<tr>
<td>Miles of HCA Pipe</td>
<td>21,727</td>
<td>20,116</td>
<td>18,830</td>
</tr>
<tr>
<td>HCA Miles Inspected</td>
<td>3,956</td>
<td>2,739</td>
<td>3,406</td>
</tr>
<tr>
<td>Number of Immediate Repairs in HCAs</td>
<td>101</td>
<td>237</td>
<td>158</td>
</tr>
<tr>
<td>Number of Scheduled Repairs in HCAs</td>
<td>595</td>
<td>403</td>
<td>405</td>
</tr>
<tr>
<td>Number of Leaks in HCAs</td>
<td>117</td>
<td>105</td>
<td>86</td>
</tr>
<tr>
<td>Number of Failures in HCAs</td>
<td>8</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>Number of Incidents in HCAs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time Dependent</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Time Independent</td>
<td>5</td>
<td>8</td>
<td>7</td>
</tr>
<tr>
<td>Stable</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
3. Pipeline Integrity Management (IM)

IM Principles
Gas IM

- Liquid IM
  - HCA Definition
  - Integrity Assessments
The federal pipeline integrity management regulations for hazardous liquid pipelines (§195.452) and natural gas pipelines (§192.901-§192.951) require operators to perform risk assessments of their pipelines to:

- Ensure that integrity assessment methods (internal inspection, pressure testing, direct assessment, etc.) are employed to address significant threats on pipeline segments.
- Ensure that assessments of threats and potential consequences are conducted.
An operator's Integrity Management Program must include the following elements:

- a process for determining which pipeline segments could affect an HCA,
- a Baseline Assessment Plan,
- a process for continual integrity assessment and evaluation,
- an analytical process that integrates all available information about pipeline integrity and the consequences of a failure,
- repair criteria to address issues identified by the integrity assessment method and data analysis,
- a process to identify and evaluate preventive and mitigative measures to protect HCAs,
- methods to measure the integrity management program's effectiveness, and
- a process for review of integrity assessment results and data analysis by a qualified individual.
**HCA Definition** (example: hazardous liquid pipelines)

- IM provides enhanced protection for defined High Consequence Areas (HCAs) which have been mapped by PHMSA and made available to industry. HCAs include:
  - unusually sensitive environmental areas (defined in 195.6),
  - urbanized areas and other populated places (delineated by the Census Bureau), and
  - commercially-navigable waterways.
Identification of HCAs in IM

- Hazardous liquid pipeline operators must develop a written Integrity Management Program that includes:
  - Identification of all pipeline segments that could affect an HCA
  - A Baseline Assessment Plan to assure integrity of these segments,
  - A Framework that identifies how each element of the Integrity Management Program will be implemented.
Integrity Assessments (example: hazardous liquid pipelines)

- U.S. mileage – 165,000 miles
- “Could affect” HCAs – 72,000 miles
- 50% of inspections completed at half way point in Sept 2004
- 100% of inspections to be completed by March 2008
- Industry has inspected more and repaired more than necessary
PPTS Onshore Pipe Incidents, '99-'06
3-Yr Average Ending Year Shown

Total, All Causes

Corrosion

Third Party

Equipment/Non-Pipe

Operator/Operating

Material/Seam/Weld

AOPI

Association of Oil Pipe Lines
4. Pipeline Economics
Economic Regulation of Oil Pipelines

- Oil pipelines are regulated as Common Carriers Under the Interstate Commerce Act
- Rates are set by four methods
  - Indexation – rates changed annually at index approved by FERC every five years
  - Market-based
  - Settlement/Negotiated
  - Cost-of-service
Economic Regulation of Natural Gas Pipelines

- Interstate natural gas pipelines are regulated as Open Access under Natural Gas Act
- Interstate natural gas pipelines are regulated by individual State Public Utility Commissions
- Rates are set by four methods
  - Cost-of-service
  - Settlement/Negotiated
  - Market-based
Pipelines – Key Economic Facts

- Oil Pipelines are the only economically regulated segment of the petroleum industry within the entire petroleum value chain – from oil field to end user.
- Oil pipelines handle 17% of nation’s freight for 2% of the cost.
- Gas Pipelines are the only economically regulated segment within the entire natural gas value chain – from gas field to end user.

Figure 1. Breakdown of Natural Gas Price Paid by Residential Consumers During the Heating Season, 2002-2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Transmission and Distribution Costs</th>
<th>Commodity (the gas itself)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002-03</td>
<td>57%</td>
<td>43%</td>
</tr>
<tr>
<td>2003-04</td>
<td>53%</td>
<td>47%</td>
</tr>
<tr>
<td>2004-05</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>2005-06</td>
<td>56%</td>
<td>43%</td>
</tr>
<tr>
<td>2006-07</td>
<td>52%</td>
<td>48%</td>
</tr>
<tr>
<td>2007-08</td>
<td>53%</td>
<td>47%</td>
</tr>
</tbody>
</table>
Depth of Cover requirement for proximity to buildings

§ 195.210 Pipeline location.
(a) Pipeline right-of-way must be selected to avoid, as far as practicable, areas containing private dwellings, industrial buildings, and places of public assembly.
(b) No pipeline may be located within 50 feet (15 meters) of any private dwelling, or any industrial building or place of public assembly in which persons work, congregate, or assemble, unless it is provided with at least 12 inches (305 millimeters) of cover in addition to that prescribed in §195.248.
## Depth of Cover requirement

<table>
<thead>
<tr>
<th>Location</th>
<th>Cover inches (millimeters)</th>
<th>For normal excavation</th>
<th>For rock excavation¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial, commercial, and residential areas</td>
<td></td>
<td>36 (914)</td>
<td>30 (762)</td>
</tr>
<tr>
<td>Crossing of inland bodies of water with a width of at least 100 feet (30 millimeters) from high water mark to high water mark</td>
<td></td>
<td>48 (1219)</td>
<td>18 (457)</td>
</tr>
<tr>
<td>Drainage ditches at public roads and railroads</td>
<td></td>
<td>36 (914)</td>
<td>36 (914)</td>
</tr>
<tr>
<td>Deepwater port safety zones</td>
<td></td>
<td>48 (1219)</td>
<td>24 (610)</td>
</tr>
<tr>
<td>Gulf of Mexico and its inlets in waters less than 15 feet (4.6 meters) deep as measured from mean low water</td>
<td></td>
<td>36 (914)</td>
<td>18 (457)</td>
</tr>
<tr>
<td>Other offshore areas under water less than 12 ft (3.7 meters) deep as measured from mean low water</td>
<td></td>
<td>36 (914)</td>
<td>18 (457)</td>
</tr>
<tr>
<td>Any other area</td>
<td></td>
<td>30 (762)</td>
<td>18 (457)</td>
</tr>
</tbody>
</table>