Pipeline Safety & Disaster Response:
Role of Weather Forecasters in Readiness & Response

Presented by:
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US Pipeline System

- Over 307,000 miles of gas transmission lines
- 1.9 million miles of gas distribution lines
- 161,000 miles of liquid pipelines
National Pipeline Mapping System

Find information about most pipelines operating in your community by accessing the National Pipeline Mapping System (NPMS)


*Please note, this site does not include gas gathering or distribution pipelines.
Oklahoma Underground Infrastructure

Do you know what’s below?
Danger Below Ground
Cleburne, Texas
Strong Winds
Agenda

Pipeline 101

Planning

Exercising

Responding
Types of Pipelines

Gathering Lines
- Steel pipelines which collect “raw” gas from the wellheads and transport product to processing plants.

Transmission Lines
- Large diameter steel lines which transport treated natural gas (methane) to utilities, power plants & industrial users.

Distribution Lines
- Smaller pipelines that deliver gas from utility to companies to homes. Can be steel, plastic or cast-iron.
Liquid Petroleum Gas

- Heavier Than Air
- Flammable
- Odorless & Colorless
Natural Gas

- Lighter Than Air
- Flammable Within Narrow Limits
- Odorless & Colorless
Natural Gas Liquids

- Heavier Than Air
- Flammable
- Odorless & Colorless
Agenda

- Pipeline 101
- Planning
- Exercising
- Responding
Pipeline Operator Emergency Plans

- Establish and maintain communication
- Make necessary resources available
- Protect people first and then property
- Perform emergency shutdown and pressure reduction
- Make safe any actual or potential hazard

Reference: PHMSA CFR 49 192.615 (natural gas) and 195.440 (liquids)
Role of the Pipeline Control Center
Working Together

Pipeline Operators

Emergency Responders
Agenda

- Pipeline 101
- Planning
- Exercising
- Responding
## Types of Exercises

<table>
<thead>
<tr>
<th>Discussion Based:</th>
<th>Operations Based:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Seminars</td>
<td>• Drills</td>
</tr>
<tr>
<td>• Workshops</td>
<td>• Functional Exercises</td>
</tr>
<tr>
<td>• Tabletop</td>
<td>• Full Scale Exercises</td>
</tr>
</tbody>
</table>
Exercises
Exercises
San Bruno, California

• 30” Natural Gas Transmission Pipeline Rupture
• 8 fatalities; numerous injuries
• 38 homes destroyed; 70 homes damaged
• Numerous evacuations implemented
• Estimated 47.6 million standard cubic feet of natural gas released
San Bruno, California
San Bruno, California
After the Flood
After the Flood
After the Flood
Pipeline Emergency Response Safety Issues

• Pipeline emergencies can present multiple hazards and challenges:
  • Flammable atmospheres
  • Toxic
  • Oxygen deficient/enriched atmospheres
  • Mechanical, pneumatic, and electrical
  • Rural and remote areas
Incident Action Plan (IAP)

• Based upon assessment of:
  • Incident potential (i.e., Visualizing HAZMAT behavior; estimating the outcome)
  • Initial operational strategy

• IAP “input” factors, including:
  • Size and type of pipeline
  • Product(s) involved
  • Nature of the incident
  • Environment of exposures
Pipeline Emergency Response Safety Issues

• Key considerations to be evaluated in developing an incident action plan are:
  • Type of pipeline
  • Product(s) involved
  • Nature of the incident
  • Exposures
  • Isolation or repair of the pipeline
  • Safety considerations
  • Environmental conditions
  • Possible escalation of the incident
Incident Commander Needs...

- Wind speeds, gusts
- Wind direction
- **WIND SHIFTS**
- Precipitation
- Humidity
- Pressure changes
Liquid Products

• Most common liquids transported:
  • Gasoline
  • Aviation gas
  • Jet fuel
  • Home heating fuels
  • Diesel fuels
  • Carbon dioxide
  • Natural gas liquids (NGL)
  • Liquefied petroleum gas (LPG)
  • Anhydrous ammonia
Highly Volatile Liquids (HVL)

• Most common HVLs transported:
  • Liquefied petroleum gas (LPG)
  • Propane
  • Butane
  • Ammonia
  • Carbon dioxide
  • Hydrogen
• Natural gas may be produced as a separate material during exploration and production operations as a by-product of crude oil production operations

• The handling of natural gas and natural gas liquids (NGLs) parallels the process for crude oil pipelines
Safe Response - Physical Properties

- Behavior of a material both in and after being released from its container
  - Specific gravity & API gravity
  - Vapor density
  - Boiling point
  - Volatility
  - Expansion ratio
  - Vapor pressure & Reid vapor pressure (RVP)
  - Solubility
  - Viscosity
Properties - Specific Gravity

- Weight of a solid or liquid material as compared with the weight of an equal volume of water
- If the specific gravity is less than 1, the material is lighter than water and will float
- If the specific gravity is greater than 1, the material is heavier than water and will sink
- Most insoluble hydrocarbons, including refined petroleum products, are lighter than water and will float on the surface (thus, they have a specific gravity of less than 1)
- Specific gravity is also a significant property for evaluating hydrocarbon spill control options and clean-up procedures for waterborne releases
Properties - Vapor Density

• Weight of a pure vapor or gas compared with the weight of an equal volume of dry air at the same temperature and pressure

• If the vapor density of a gas is less than 1, the material is lighter than air and may rise. If the vapor density is greater than 1, the material is heavier than air and will collect in low or enclosed areas

• All hydrocarbon liquids that are shipped via pipeline have vapors that are heavier than air and will collect in low or enclosed areas

• In contrast, natural gas is lighter than air and will rise when released
Properties - Boiling Point

• Temperature at which a liquid changes its phase to a vapor or gas

• The boiling point can also be described as the temperature at which the vapor pressure of the liquid equals atmospheric pressure

• The lower the boiling point, the more vapors that are produced at a given temperature

• The closer a material is to its boiling point, the more vapors that are produced

• A low flash point flammable liquid will also have a low boiling point, which translates into greater amounts of vapors being given off
Properties - Volatility

• The ease with which a liquid or solid can pass into the vapor state
• The higher a material’s volatility, the greater its rate of evaporation
• Vapor pressure is a measure of a liquid’s propensity to evaporate; the higher a liquid’s vapor pressure, the more volatile the material
Properties - Expansion Ratio

- The amount of gas produced by the evaporation of one volume of liquid at a given temperature
- This is a significant property when evaluating liquid and vapor releases of liquefied
- The greater the expansion ratio, the more gas that is produced and the larger the hazard area
- Liquefied petroleum gas has an expansion ratio of 1 part liquid to 270 parts vapor
Properties - Vapor Pressure

- The pressure exerted by the vapor within the container against the sides of a container
- This pressure is temperature dependent
- As the temperature increases, so does the vapor pressure
- The vapor pressure of a substance at 100°F (37.7°C) is always higher than the vapor pressure at 68°F (20°C)
- Vapor pressures reported in millimeters of mercury (mm hg) are usually very low pressures
- 760 mm hg is equivalent to 14.7 psi or 1 atmosphere
- Materials with vapor pressures greater than 760 mm hg are usually found as gases
- The lower the boiling point of a liquid, the greater vapor pressure at a given temperature
Properties - Viscosity

- Measurement of the thickness of a liquid and its ability to flow
- High-viscosity liquids, such as heavy fuels oils (i.e., #6 fuel oil), must first be heated to increase their fluidity
- A low-viscosity liquid (i.e., Gasoline) will spread like water and increase the size of the hazard area
Chemical Properties

• The product’s tendency to undergo chemical change

• Bad things happen because of:
  • Flash point
  • Fire point
  • Ignition (auto ignition) temperature
  • Flammable Range / Explosive Range
Flash Point

- Minimum temperature at which a liquid gives off sufficient vapors that will ignite and flash over but will not continue to burn without the addition of more heat
- Significant in determining the temperature at which the vapors from a flammable liquid are readily available and may ignite
- Flash point less than 140ºF (60ºC) are a flammable liquid
- Flash point from 141ºF to 200ºF (61ºC to 93ºC) are defined as combustible liquids
- Flash point is also linked to boiling point and vapor pressure; liquids with a low flash point liquids will typically have low boiling points and increasing vapor pressures
Flash Point versus Fire Point

• Fire Point is:
  • Minimum temperature at which a liquid gives off sufficient vapors that will ignite and sustain combustion
  • It is typically several degrees higher than the flash point of the liquid
Ignition Temperature

• Ignition (auto ignition) temperature — the minimum temperature required to ignite gas or vapor without a spark or flame being present

• Ignition temperature is significant in evaluating the ease at which a flammable material may ignite

• Materials with lower ignition temperatures generally have a greater risk of ignition
Smoke on the Horizon
Above Ground Hazards
Multiple Operators
Two Jasper Co. wildfires limiting firefighting resources

(June 20, 2011 News 9 KTRE)

Texas Forest Service officials said a bulldozer became stuck on a pipeline, creating the risk of an explosion.
Other Hazards
We’ve Discussed

- Pipeline 101
- Planning
- Exercising
- Responding
Special thanks to:

• Williams
• Council on Firefighter Training
• Oklahoma State Fire Marshal
• National Association of State Fire Marshals
Questions?

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