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Reducing Methane Emissions in Pipeline Maintenance and Repair

IAPG & US EPA Technology Transfer Workshop

November 6, 2008
Buenos Aires, Argentina

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Pipeline Maintenance and Repair: Agenda

- Methane Losses from Pipeline Maintenance
- Methane Recovery from Hot Taps
- Methane Losses from Major Pipeline Repairs
- Methane Recovery Using Pipeline Pumpdowns
- Methane Recovery from Pipeline Pigging
- Discussion Questions

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Methane Losses from Current Pipeline Maintenance Practices

- Natural gas is often vented to the atmosphere when performing pipeline repairs and new connections
  - Up to 170 thousand cubic meter (Mm^3)* natural gas vented when making a new connection or non-leaking repairs
  - Quantity depends on pipe diameter, length between isolation valves and operating pressure
- These practices have typically resulted in methane emissions
  - Loss of sales
  - Service disruption and customer inconvenience
  - Costs of gas-freeing the existing piping system

*pipelines range from 10 to 46 centimeters diameter, 3 to 16 km between valves and operating pressure between 7 to 68 atm.

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Methane Recovery: Hot Taps for New Connections

- Connecting pipelines without service disruption or methane emissions

Certified Williamson Industries Technician performing a hot tap with a 760 Tapping Machine as part of a 12" Stopple application.

Source: Williamson Industries Inc.

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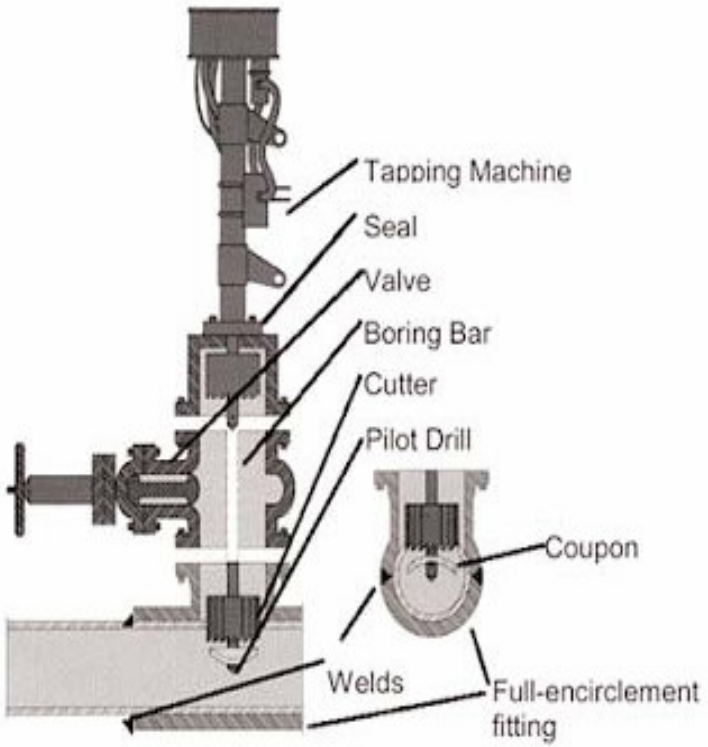
Hot Tapping Procedure

- Connect branch fitting and permanent valve on the existing pipeline while in service
- Install hot tapping machine on the valve
- Cut through pipeline wall and extract coupon through the valve
- Close valve and remove hot tapping machine
- Connect branch line



Source: IPSCO

Schematic of Hot Tapping Machine

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Hot Tap Benefits

- Continuous system operation – shutdown and service interruptions are avoided
- No gas released to the atmosphere
- Avoided cutting, realignment and re-welding of pipeline sections
- Avoid inerting / gas-freeing pipeline section for hot work
- Reduced planning and coordination costs
- Increased worker safety

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Methane Losses from Major Repairs

- Not always possible to repair a pipeline without taking it out of service
- Major pipeline repairs often involve isolating the repair area and venting gas to the atmosphere
  - Major repairs
  - Internal defects
  - Leak repairs
  - Installing large connections
- 1 to 170 Mm^{3*} natural gas vented to the atmosphere with each repair

*on pipelines ranging from 10 to 46 centimeters inside diameter, 16 km between isolation valves and 7 to 68 atm.

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Industry Experience

- One hot tap vendor reported helping a gas transmission client avoid a service outage
  - One day gas delivery in a 91-cm natural gas pipeline operating at 68 atm is worth US$243.000 in gross revenue
  - Performing a shutdown connection required 4 days
  - Revenue savings was estimated at US$972.000

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Methane Recovery Using Pipeline Pumpdowns

- Minimizing emissions when you must cut out a section of pipeline

Source: Duke Energy

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Pipeline Pumpdown Procedure

- Use in-line compressors to “pull down” the pressure to minimum suction pressure
- Use portable compressor to “pull down” pressure even further
- Cost is justified by immediate payback in gas savings
- About 90% of gas usually vented is recoverable

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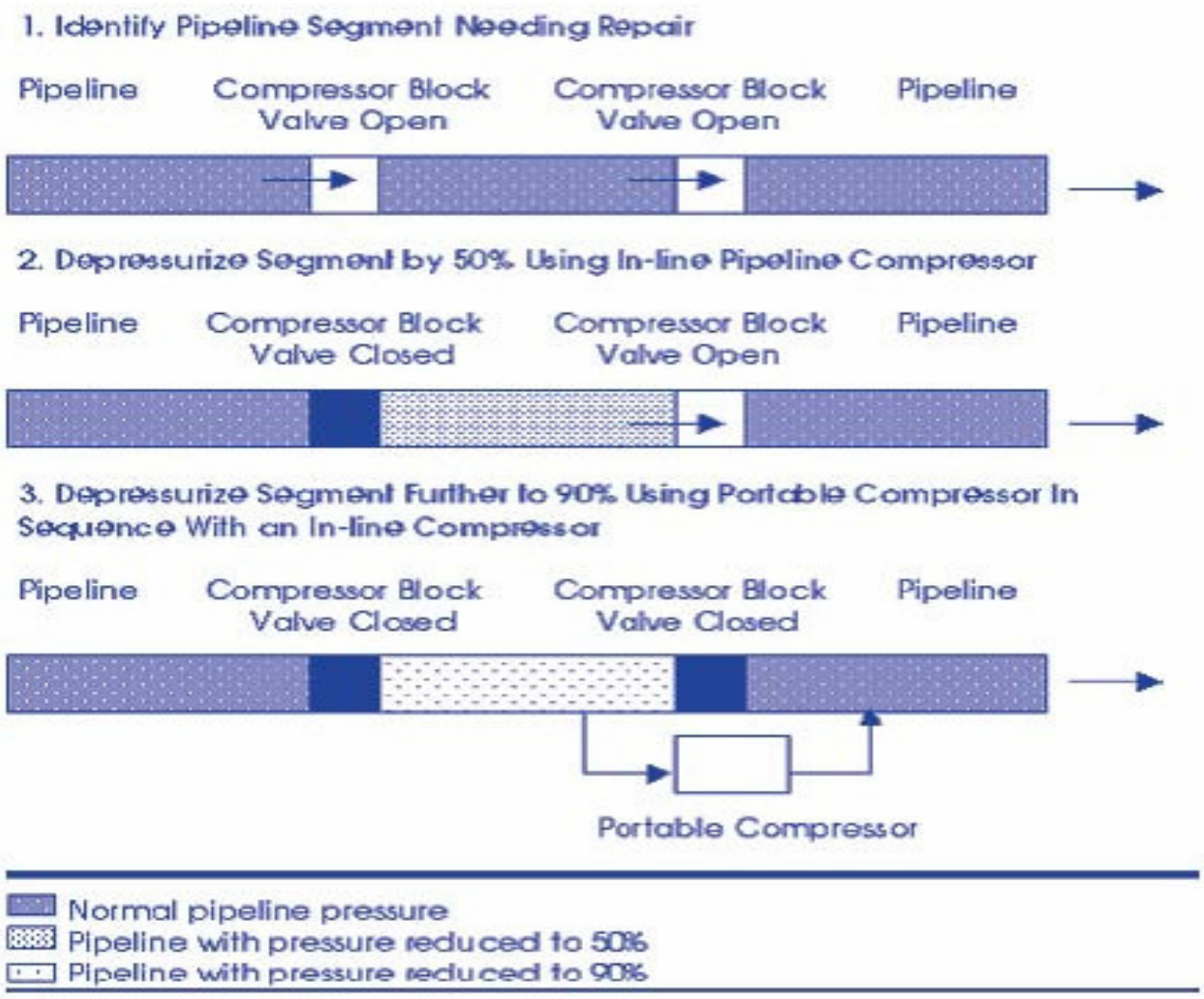
Sequence of Depressurization Events



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Pipeline Pumpdown Equipment

- In-line pipeline compressor
  - Typically has compression ratio of 2 to 1
  - Blocking upstream valve reduces pipeline pressure with no additional equipment costs
- Portable compressor
  - Typically has compression ratio of 5 to 1
  - Can be used in conjunction with in-line compressor to further reduce pressure in the pipeline section
  - Justifiable only when multiple sections of pipeline are to be serviced (i.e. long sections of maintenance or pipeline valve station maintenance where stopples are not feasible)

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Economics of Pipeline Pumpdown

- Calculate gas vented to atmosphere by depressuring pipeline
- Calculate gas saved with in-line compressors
- Calculate gas saved with portable compressor
  - Consider cost of a portable compressor
  - O&M costs of a portable compressor
  - Consider fuel costs for operating portable compressor
- Calculate the net gas savings

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Pipeline Pumpdown in Argentina

- Over 24.900 km of gas pipelines in Argentina; currently gas transmission companies do not appear to employ pipeline pumpdown as a maintenance activity
- Pipeline pumpdown using portable compressors is a viable opportunity
- Example vendors of portable compressors with presence in Argentina:
  - **Ariel Compressors**
  - **Knox Western**

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Industry Experience

- U.S. Natural Gas STAR partner Southern Gas used compressors three times at one location
- Estimated total cost = US$52.600
- Gas saved from being vented = 922 Mm^3
- Gross savings at Argentina price* = US$65.100
- Net savings = US$12.500
- Even at Argentina gas price, practice pays back immediately

*Argentina gas price assumed to be US$70,63 per thousand cubic meter.

Methane Recovery from Pipeline Pigging

- Hydrocarbons and water condense inside wet gas gathering lines, causing pressure drop and reducing gas flow
- Periodic line pigging removes liquids and debris to improve gas flow
- Efficient pigging:
  - **Keeps pipeline running continuously**
  - **Keeps pipeline near maximum throughput by removing debris**
  - **Minimizes product losses during launch/capture**

http://www.girardind.com/

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Pigging Applications

- Pipeline pigs come in a variety of shapes and sizes for different applications
  - **Cleaning pigs**
    - **Have brushes or blades to help remove debris**
  - **Sealing pigs**
    - **Make tight seal for removing liquids from the pipe**
  - **Inspection pigs**
    - **Specialized pigs outfitted with instruments to monitor the pipeline integrity**

www.westernfilterco.com

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Pigging and Methane Losses

- Gas lost when launching and receiving a pig
- Fugitive emissions from pig launcher / receiver valves
- Gas lost from storage tanks receiving condensate removed by pigging
- Gas vented from pipeline blowdowns

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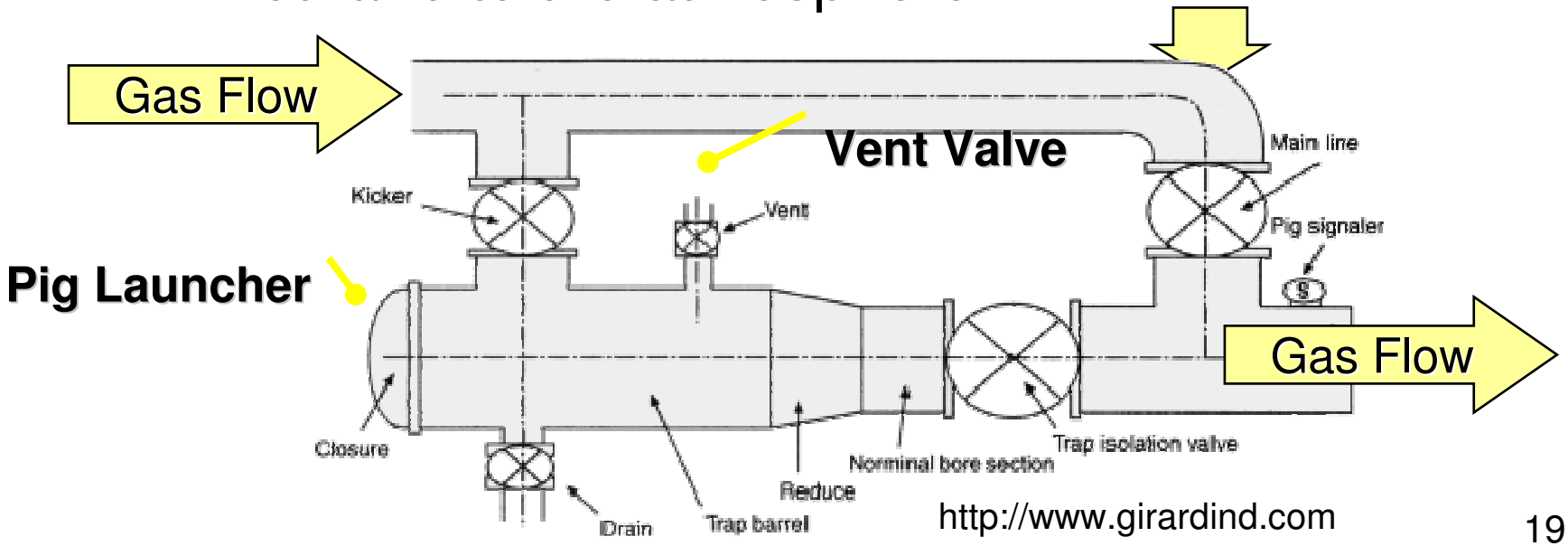
How Does Pigging Vent Methane?

- Gathering lines have built-in pig launchers
- Pig launchers have isolation valves for loading pigs, pressurizing pig launcher, and launching pigs with gas bypassed from the pipeline
- Launcher depressuring for inserting a pig vents methane to the atmosphere



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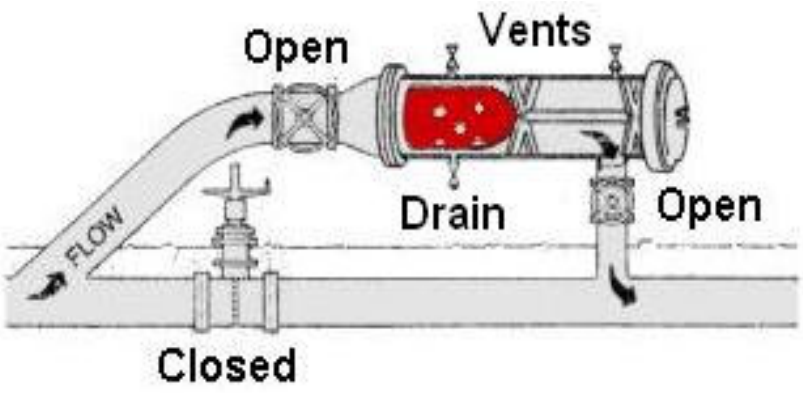
Pigging Vents Methane Twice

- Methane is vented from the launcher and again from the pig receiver
  - **Once receiver is isolated from the line, it must be depressured to remove the pig**
  - **Liquids ahead of the pig drain to a vessel or tank**
- More than twice:
  - Isolation valve leaks may cause excessive venting to depressure



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Estimating Pigging Vents

- $E = P * V * n * f$

  where:

  E = methane emissions (m^3)

  P = Gathering line pressure (atm)

  V = Launcher and receiver volume (m^3)

  n = % methane

  f = number of piggings

- Pig trap isolation valve leakage increases this minimum amount of gas venting

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Estimating Emissions from Pigging

- Estimating n
  - Default = 78,8
- Estimating P
  - Default = 21,43 atm
- Estimating V

Line Diameter (cm)	V (m^3)
6 in 15,24	0,025
12 in 30,48	0,130
18 in 45,72	0,326
26 in 66,04	0,784
34 in 86,36	1,846
48 in 121,92	4,834

Adapted from http://www.pigsunlimited.com

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Gas Recovery from Pipeline Condensate Storage Tanks

- Pressurized condensate collected from pigging is normally transferred to an atmospheric (fixed roof) tank
- Gas released during atmospheric flashing can be recovered using a vapor recovery unit (VRU) rather than venting the gas
- Facilities with existing pigging and liquid storage capabilities can install an electric or gas powered VRU compressor to recover flashed gasses
- Pig receiver vent can also be piped to the VRU for additional gas savings

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Industry Experience

- One partner pigged gathering lines 30 to 40 times per year, collecting several thousand barrels of condensate per application
- Partner reported saving 606 Mm^3/year
- Dedicated vapor recovery unit (VRU) was installed with an electric compressor
- Large gas savings and rising gas prices offset costs

Gas Price (US$/$Mm^3$)	70,63	105,94	141,26
Gas Saved (Mm^3/year)	606	606	606
Annual Savings (US$/year)	42.800	64.200	85.600
Installed Cost (US$)	24.000	24.000	24.000
Operating Cost (US$/year)	40.000	40.000	40.000
Payback Period (years)	8,6	1,0	0,5

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Discussion Questions

- To what extent are you implementing these practices?
- How could these practices be improved upon or altered for use in your operation(s)?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing these practices?