

# Air Emissions from Natural Gas Pipeline Pigging Operations



---

PRESENTATION FOR NOGC

DECEMBER 12, 2019



# Disclaimer

---

*This presentation or document should not be construed as a regulation, policy, guidance, or the outcome of a scientific inquiry. The document is not a regulation itself, nor does it change or substitute for those provisions and regulations. Thus, this document does not impose legally binding requirements on the EPA, States, or the regulated community. This document does not confer legal rights or impose legal obligations upon any member of the public. This document is not a guidance document nor is it EPA policy. Mention of any group, trade name, or commercial product does not constitute an endorsement or recommendation by the EPA. This document may be modified without any further notice.*

# Citizen Complaints- Marcellas Shale Gas Region of Southwestern Pennsylvania





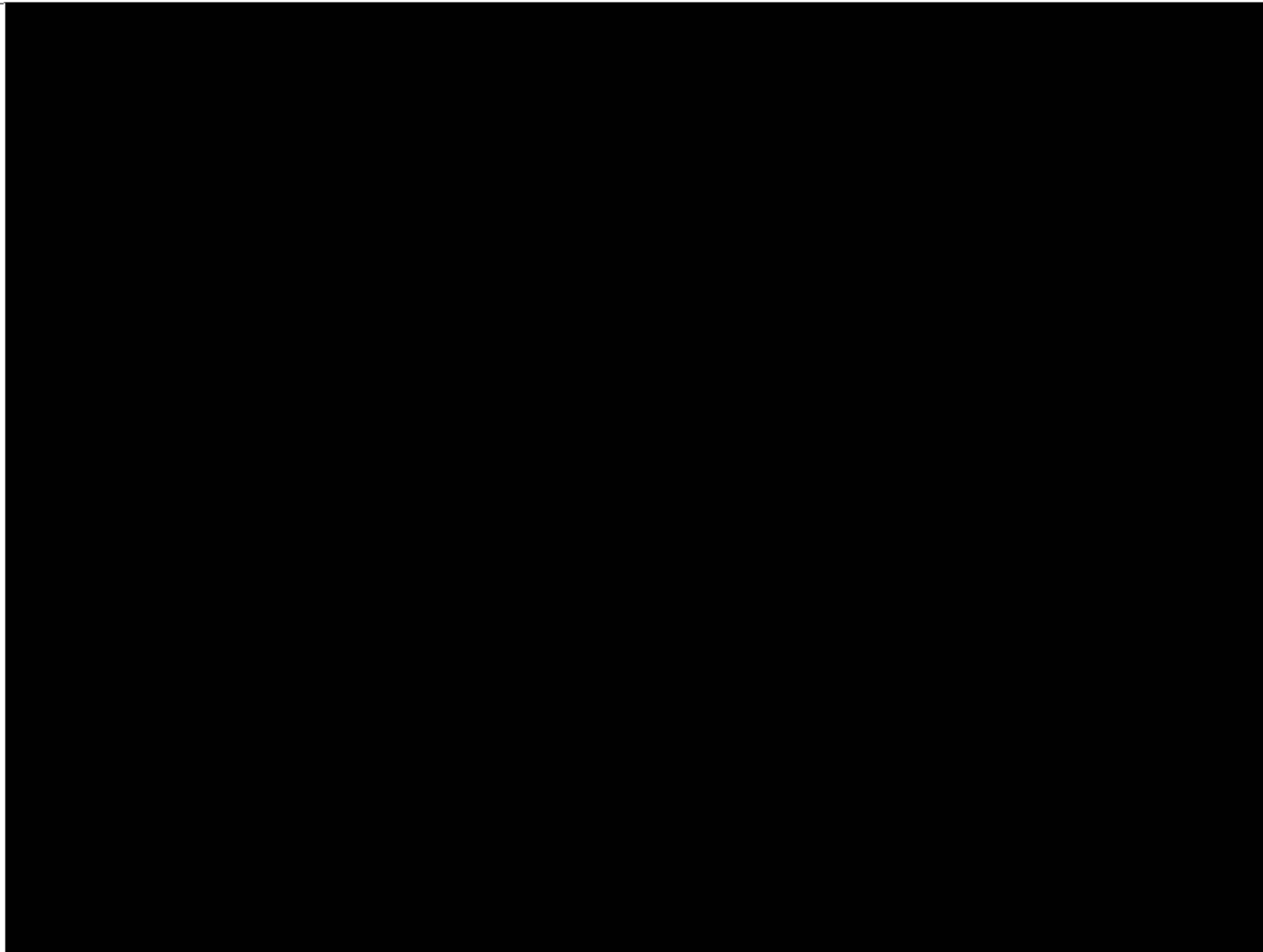
# OGI Video of Emissions from Pigging Operations





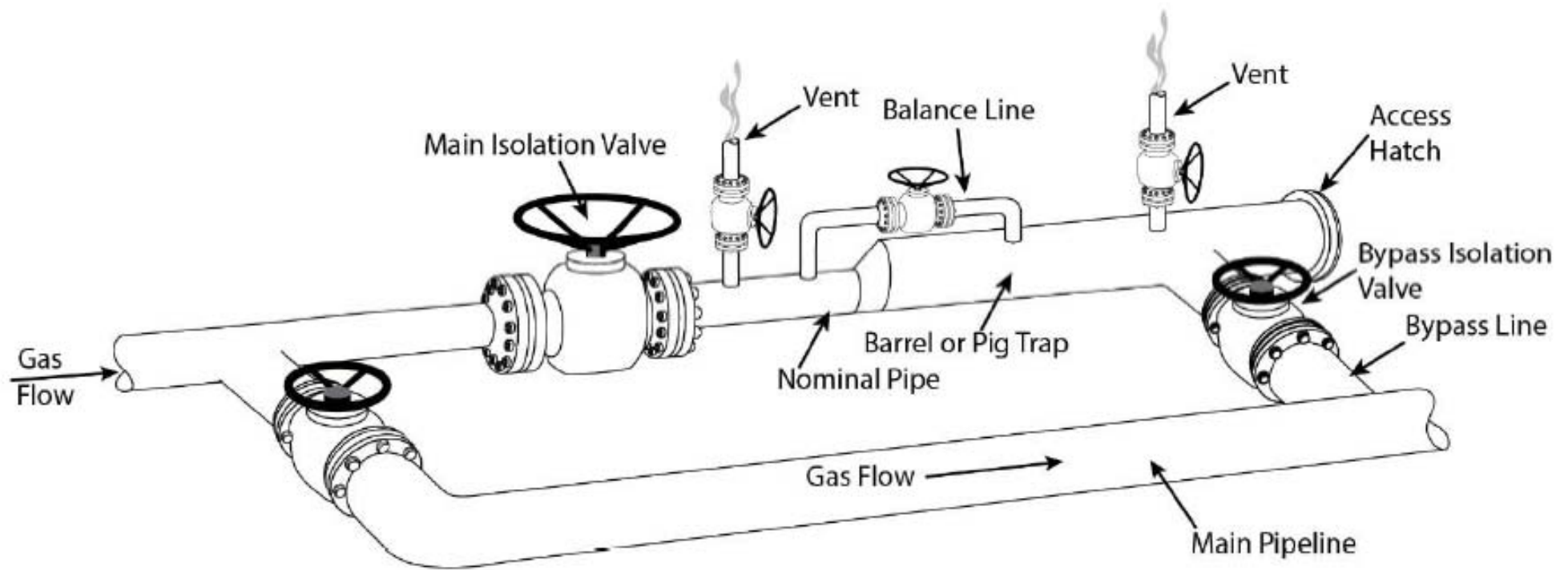
# Pig Launching and Receiving Operations

---





# Typical Launcher and Receiver Design





# Examples of Noncompliance

---

- Failure to obtain required permits;
- Failure to adhere to permit application representations;
- Failure to comply with recordkeeping requirements; and,
- Failure to control emissions.

## Excess or Unauthorized VOC Emissions.



# Basis for Estimating Mass Emissions

$$m_{emissions} = \frac{P_{rec} \times (V_{rec} - V_{liq})}{Z_{NG-pip} \times R \times T_{rec}} \times MW_{NG-pip} + \rho_{liq} \times V_{liq}$$

$m_{emissions}$  = Mass of emissions per depressurization event (pounds per event)

$P_{rec}$  = Pressure in the receiver prior to depressurization (psig)

$T_{rec}$  = Temperature of the natural gas mixture in the receiver prior to depressurization ( $^{\circ}R$ )

$Z_{NG-pip}$  = Compressibility factor of the pipeline natural gas at  $T_{rec}$  and  $P_{rec}$

$V_{rec}$  = Volume of the launcher or receiver between isolation valves (scfm)

$MW_{NG-pip}$  = Molecular weight of the pipeline natural gas (lb - mol)

$R$  = Gas Constant, or  $10.73159 \frac{ft^3 \times psig}{^{\circ}R \times lb - mol}$

$V_{liq}$  = Volume of hydrocarbon liquid in the launcher or receiver ( $ft^3$ )

$\rho_{liq}$  = Density of hydrocarbon liquid ( $lb/ft^3$ )





# Basis for Estimating Mass Emissions

---

$$m_{VOC} = \frac{P_{rec} \times (V_{rec} - V_{liq})}{Z_{NG-pip} \times R \times T_{rec}} \times MW_{NG-pip} \times y_{VOC} + \rho_{liq} \times V_{liq} \times x_{VOC}$$

$m_{VOC}$  = Mass of VOC emissions per depressurization event (pounds VOC per event)

$y_{VOC}$  = mass fraction of VOC in the vapor phase

$x_{VOC}$  = mass fraction of VOC in the liquid phase

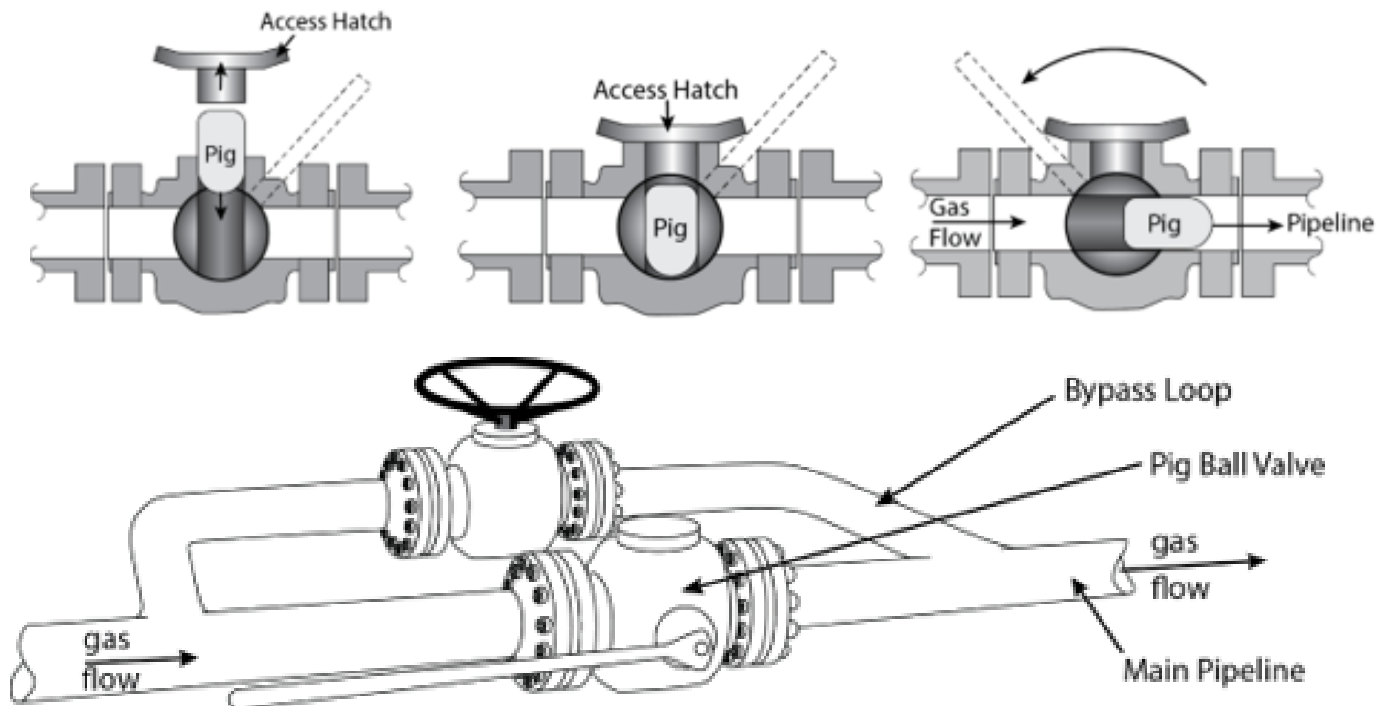
$$M_{VOC} = \frac{m_{VOC} \times f_{pigging}}{2000 \frac{lb}{ton}}$$

$M_{emissions}$  = Annual mass of VOC emissions (tons of VOC per year)

$f_{pigging}$  = Annual frequency of pigging events (depressurization events per year)

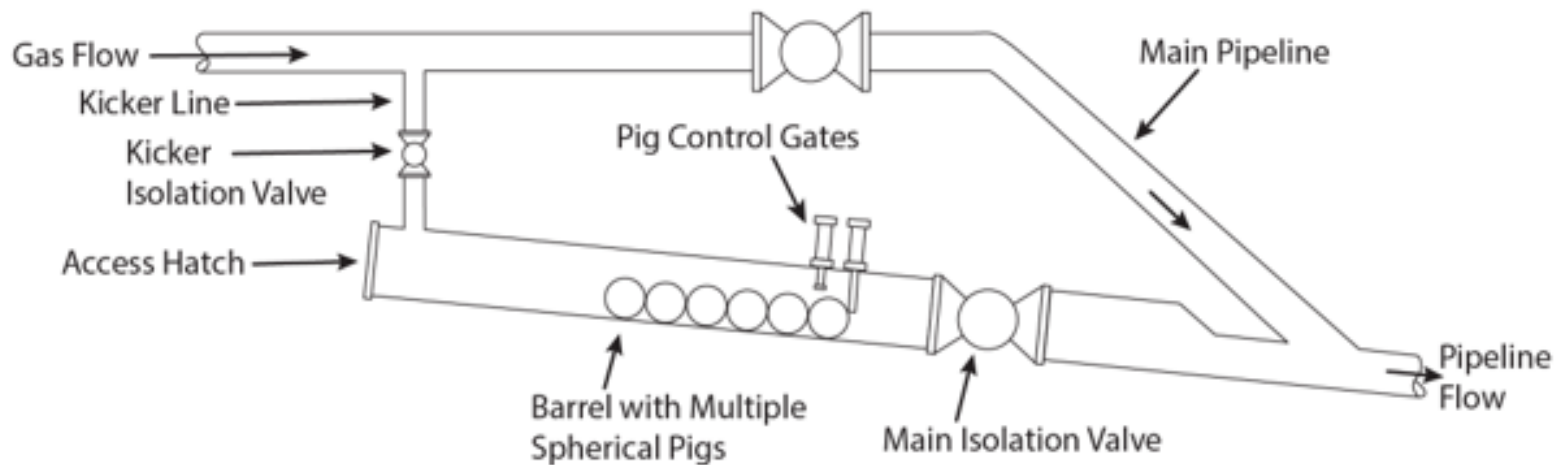
# Emissions Reduction Strategies

- Pig Ball Valve



# Emissions Reduction Strategies

- Multi-Pig Launcher Systems





# Emissions Reduction Strategies

---

- Barrel Pump-down Systems (e.g., ZEVAC)

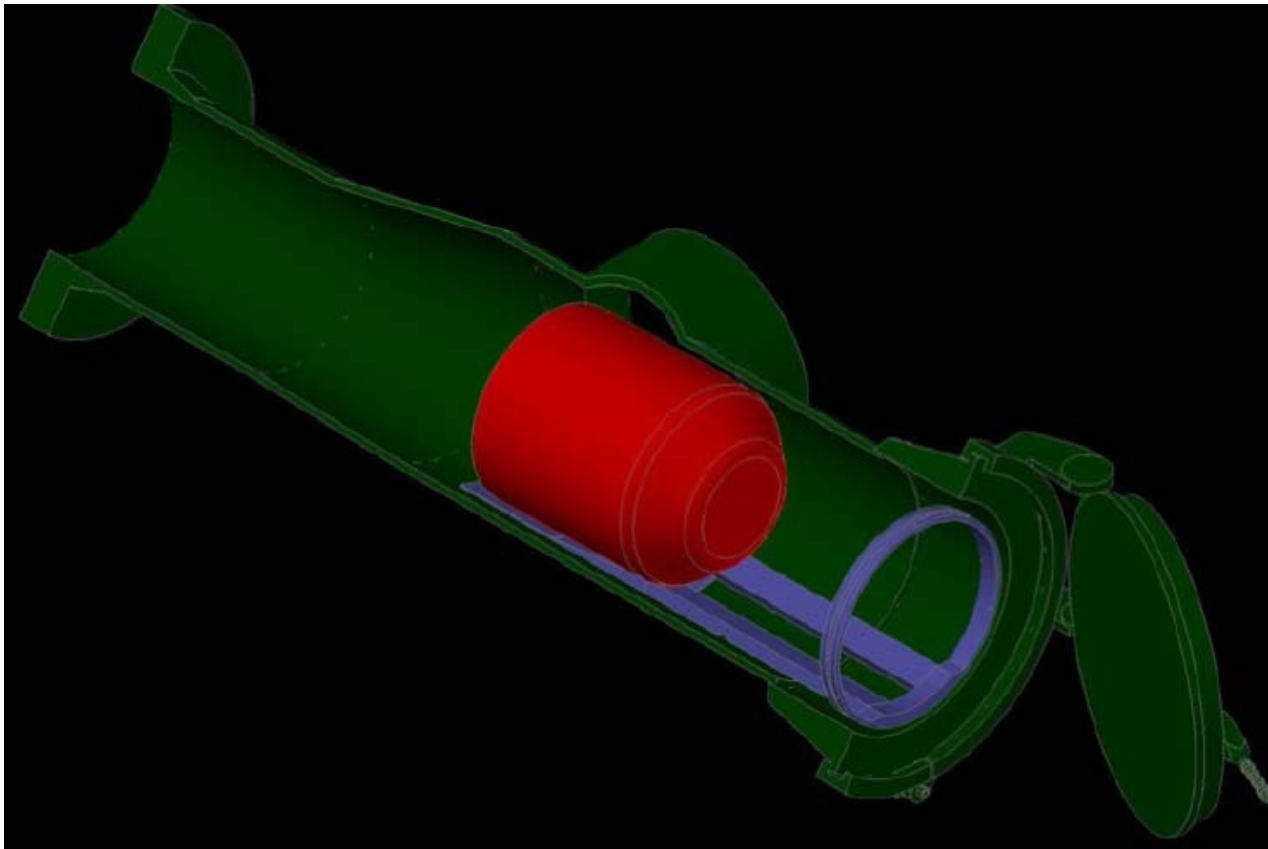




# Emissions Reduction Strategies

---

- Pig Ramp





# Emissions Reduction Strategies

---

- Route Emissions to Lower Pressure Lines
- Install Condensate Drains
- Route Emissions to Combustion Device
- Others?



# MarkWest Consent Decree (7/9/18)

---

MarkWest agreed to injunctive relief at over 300 facilities in Ohio and Pennsylvania to reduce VOC emissions by more than 700 tpy (or 91.5% reduction) system-wide:

- installation and use of high pressure pig launchers and receivers by jumper lines to a low pressure gathering line;
- installation and use of pig ramps in pig receivers;
- use of a mobile ZEVAC or flare to control emissions;
- liquid containers with lids and strike protection; and,
- obtain permits and make permit corrections.

PENALTY: \$610K    SEP: Tech transfer project and air monitoring in PA and OH (\$2.4M)



# EPA Enforcement Alert

---

Located at-

<https://www.epa.gov/sites/production/files/2019-09/documents/naturalgasgatheringoperationinviolationcaa-enforcementalert0919.pdf>