High Pressure Casinghead Gas Flaring

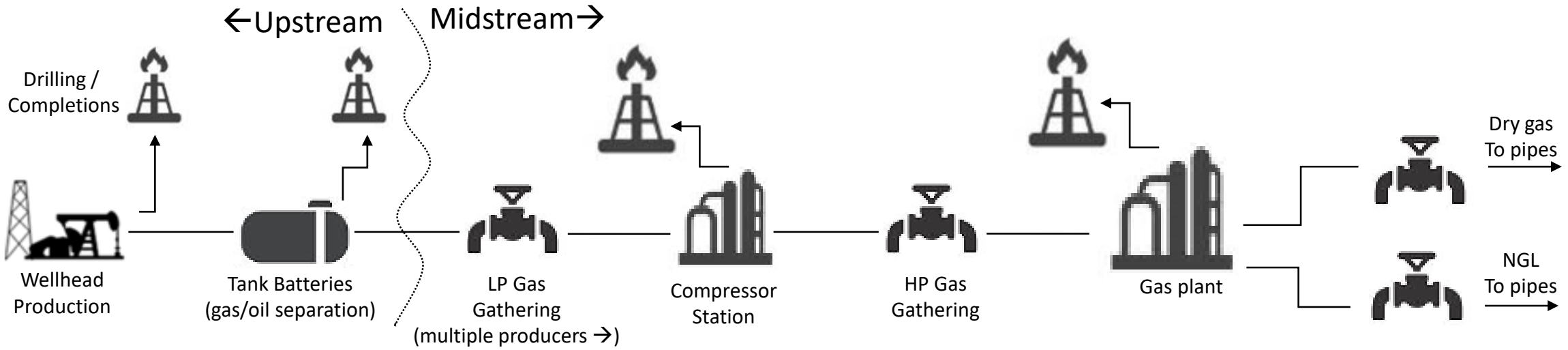
Enhancing the Understanding Around Flaring:
Technical Explanation of Why Industry Flares and Recommended Improvements

October 11, 2019
Presentation to New Mexico Methane Advisory Panel

Reasons for Flaring

- Relieve pressure for safety reasons
- Gas is off-spec (O2, H2S)
- Maintenance activities including pigging, compressor turnarounds, etc.
- Unplanned shutdowns, emergencies, force majeure events, equipment reliability
- Electrical infrastructure reliability including adverse weather

- Capacity constraints on multi-operator systems
- Vessels operating at lower pressures than system
- Drilling & completions activities (OOOOa)
- Waiting on pipeline right-of-way
- Wildcat wells in undeveloped areas



Consequences of Shutting In or Curtailing Production

Why can't the well just be shut-in?

- If every operator shuts in upon flaring, the system pressure swings up/down, and can take down compressor stations on low flow.
  - *This can compound the situation, leading to more flaring*
- Operational activities to clear liquids from pipelines must be conducted.
  - *Temporarily puts backpressure on the facilities, which can lead to flaring*
  - *Causes line clearing equipment to become stuck*
- Shutting in a well can "kill" a flowing well.
  - *Resource is stranded until expensive and premature intervention or artificial lift can be deployed*

- Frequent shut-ins of flowing (new) wells has been shown to reduce a well's ultimate recovery.
  - *Increases waste or stranding of resource*
  - *Stress cycling on the proppant can cause damage to the completion [Permian completions $3-6M typical]*

Areas for Consideration

- Measurement and Estimation Methods
- Percent Gas Capture Goals
- Gas Capture Plans
- Remote Capture Technologies

Measurement and Estimation of Flare

Consistent and accurate reporting is necessary

Standardized methods for measuring/estimating are required to improve NM dataset

- Accurate flare measurement must include safety considerations, gas composition and rate changes, and liquid drop out (API MPMS 14.10); technology is improving

Common Meter Types*	Limitations	Cost
Differential Pressure (Orifice)	Adds pressure drop (safety), gas composition, rate change, calibration challenge	Low - High
Thermal Mass	Gas composition, moisture	Medium
Ultrasonic	Low velocity, moisture	High

- Estimation methods include:
  - Use of use of a gas-oil-ratio (GOR): Flare = GOR*Oil – Sales – Beneficial Use
  - Prior period sales data: Flare = Yesterday Sales – Today Sales
  - Production meter: Flare = Produced Gas – Sales – Beneficial Use

*Provided by North Dakota Petroleum Council

Percent Gas Capture Goals

Currently, there is not sufficient data to inform appropriate numerical percent capture; ***additional technical information needed***

- North Dakota experience: 2 phases of extensive data gathering/analysis to develop capture plan using an independent 3rd party to evaluate holistic gas takeaway and long term supply growth
- Perform study on compression and electrical grid reliability & redundancy
- Expand on API-NMOGA study to detail pipeline, compression & plant capacity constraints related to development pace
- Evaluate NM right-of-way timing improvements
- Study SE NM gas-oil-ratios (10+ producing zones with different GORs)

Gas Capture Plans

Producer and midstream alignment is critical

- The Gas Capture Plan (GCP) is a communications tool developed between the producer and gatherer, promoting early and continued communication
- GCPs should allow for flexibility and recognition that field plans will evolve
- Current GCP requires improvement to ensure proper planning occurs
  - Example: Midstream entity evaluates expected regional volumes for assessment in its hydraulic analysis
    - *Only the midstream entity can provide this analysis because they see the entire gas network and have access to all operators' confidential forecasts*
  - Include expected gas takeaway strategy and capacity at future date of completion

Remote Capture Equipment

Incentives for uneconomic technology alternatives may increase their use

Remote Capture Technology

- Mobile NGL, CNG & LNG equipment can be used to truck molecules in absence of pipeline
- Stranded gas can be used for power generation
- Gas-fired power generation common in NM; other technologies are mostly early stage

Learnings from North Dakota

- Economics are challenged
  - Equipment must be moved as wells decline
  - Poor performance when used secondary to permanent sales (auto restart not typical)
  - Large capital investment or rental
- Spacing constraints on site
- Additional truck traffic
- Need a destination (gas plant with space)