Reduced Emission Completions (Green Completions)

Lessons Learned from Natural Gas STAR

Producers Technology Transfer Workshop

Devon Energy and EPA’s Natural Gas STAR Program

Casper, Wyoming

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Green Completions: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions
Methane Losses During Well Completions

- It is necessary to clean out the well bore and formation surrounding perforations
  - After new well completion
  - After well workovers
- Operators produce the well to an open pit or tankage to collect sand, cuttings and reservoir fluids for disposal
- Vent or flare the natural gas produced
  - Venting may lead to dangerous gas buildup
  - Flaring is preferred where there is no fire hazard or nuisance
Methane Losses: Well Completions and Workovers

☆ An estimated 45.5 Bcf of natural gas lost annually due to well completions and workovers¹
  ◆ 45,000 MMcf in losses from high pressure wells
  ◆ 319 MMcf in losses from low pressure wells
  ◆ 48 MMcf in losses from workovers

☆ An estimated total of 480,000 Bbl condensate lost annually due to venting and flaring

☆ This amounts to over $145 million lost due to well completions and workovers

Note:
- ¹Percentage that is flared and vented unknown
- Value of natural gas at $3/Mcf
- Value of condensate at $22/bbl
Methane Recovery by Green Completions

★ Green completions recover natural gas and condensate produced during well completions or workovers
★ Use portable equipment to process gas and condensate suitable for sales
★ Direct recovered gas through permanent dehydrator and meter to sales line, reducing venting and flaring
★ An estimated 25.2 Bcf of natural gas can be recovered annually using Green Completions
  ◆ 25,000 MMcf from high pressure wells
  ◆ 181 MMcf from low pressure wells
  ◆ 27 MMcf from workovers
Green Completions: Equipment

★ Truck or trailer mounted equipment to capture produced gas during cleanup
  ◇ Sand trap
  ◇ Three-phase separator
★ Use portable desiccant dehydrator for workovers requiring glycol dehydrator maintenance

Temporary, Mobile Surface Facilities,
Source: BP
Green Completions: Preconditions

- Must have permanent equipment on site before cleanup
  - Piping from well-head to sales line
  - Dehydrator
  - Lease meter
  - Stock tank
- Sales line gas can be used for fuel and/or gas lift in low pressure wells
Green Completions: Low Pressure Wells

- Can use portable compressors to start-up the well when reservoir pressure is low
  - Artificial gas lift to clear fluids
  - Boost gas to sales line
- Higher cost to amortize investment in portable equipment

Portable Compressors, Separator and Other Equipment on a trailer
Source: Herald
Is Recovery Profitable?

- Partners report recovering 2% - 89% (average of 53%) of total gas produced during well completions and workovers.

- Estimate 7-12,500 Mcf (average of 3,000 Mcf) of natural gas can be recovered from each cleanup.

- Estimate 1-580 Bbl of condensate can be recovered from each cleanup.

Note: Values for high pressure wells.
Green Completions: Benefits

- Reduced methane emissions during completions and workovers
- Sales revenue from recovered gas and condensate
- Improved relations with state agencies and public neighbors
- Improved safety
- Reduced disposal costs
BP Experience

- Capital investment ~ $1.4 million on portable three-phase separators, sand traps and tanks
- Used Green Completions on 106 wells
- Total natural gas recovered ~ 350 MMcf/year
- Total condensate recovered ~ 6,700 Bbl/year
BP Experience

★ Total value of natural gas and condensate recovered
  ~ $840,000 per year
★ Investment recovered in 2+ years

Note:
- Value of natural gas at $1.99/Mcf
- Value of condensate at $22/bbl

Portable Three Phase Separator, Source: BP
Weatherford Durango Experience

★ Successfully completed pilot project in the Fruitland coal formations in Durango, Colorado
  ◆ Well depth: 2,700 to 3,200 feet
  ◆ Pore pressure: estimated at 80 pounds per square inch gauge (psig)
  ◆ Well type: coal bed methane
  ◆ Hole size: 5 ½ inches
  ◆ No. of wells: 3 well pilots
★ Captured 2 MMcf of gas and sold by client
Weatherford Green Completions

- Use pipeline gas with proprietary foaming agent as compressible fluid to initiate cleanout

- System includes
  - Wet screw compressor when well pressure is less than 80 psig
  - Booster compressor, three phase separator and sand trap

- Estimate cleanup pressure of 300 to 400 psig at a well depth of 8000 feet

- Suggest use in all kinds of completion and workover cleanup operations
Discussion Questions

- To what extent are you implementing this opportunity?
- Can you suggest other approaches for reducing well venting?
- How could these opportunities be improved upon or altered for use in your operation?
- What are the barriers (technological, economic, lack of information, regulatory, focus, manpower, etc.) that are preventing you from implementing this practice?