

Green Completions

Lessons Learned
from Natural Gas STAR



Producers Technology Transfer Workshop

ExxonMobil Production Company,
American Petroleum Institute and
EPA's Natural Gas STAR Program

September 21, 2004

Green Completions: Agenda

- Methane Losses
- Methane Recovery
- Is Recovery Profitable?
- Industry Experience
- Discussion Questions



Methane Loss During Well Completions

- It is necessary to clean out the well bore and formation surrounding perforations
 - ◆ After new well completion
 - ◆ After well workovers
- 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 no fire hazard or nuisance



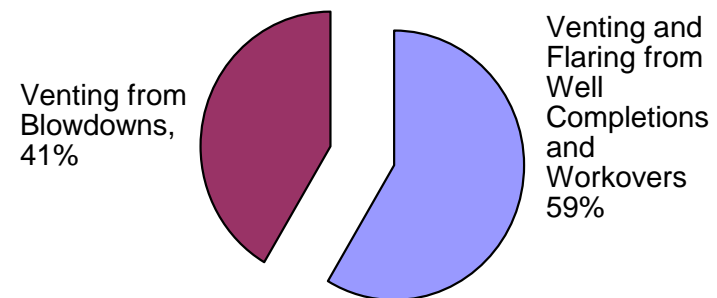
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Methane Losses: Well Completions and Workovers

- EIA reported annual losses due to flaring and venting from onshore gas well completion, workovers and blowdowns to be 76 Bcf
- Estimated 45 billion cubic feet (Bcf) of natural gas lost annually due to well completions and workovers¹
- Estimated a total of 480,000 barrels (Bbl) condensate lost annually due to venting and flaring
- A total of \$145 million lost due to well completions and workovers

Annual Natural Gas Venting and Flaring



Note:

- ¹Percentage that is flared and vented is not known
- Value of natural gas at \$3/Mcf
- Value of condensate at \$22/bbl



Methane Recovery by Green Completions

- ❑ Recover natural gas and condensate produced during well completions or workovers
- ❑ Estimated 24 Bcf of natural gas can be recovered annually using Green Completions
- ❑ 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



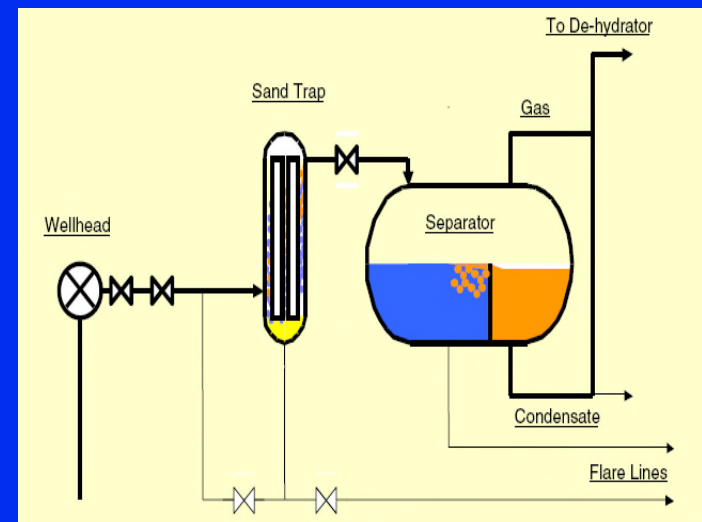
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Green Completions: Equipment

- 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

- Permanent equipment on site before cleanup
 - ◆ Piping to well head
 - ◆ Dehydrator
 - ◆ Lease meter
 - ◆ Stock tank
- Sales line gas can be used for energy and/or gas lift in low pressure wells



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Green Completions: Low Pressure Wells

- Use portable compressors when pressure in well is low
 - ◆ Artificial gas lift to clear fluids
 - ◆ Boost gas to sales line
 - ◆ Higher cost to amortize investment



JERRY McBRIDE / Herald

Portable Compressors, Separator and Other Equipment on a trailer

Source: Herald



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



Is Recovery Profitable?

- Partners report recovering 2% to 89% (average of 53%) of total gas produced during well completions and workovers
- Estimated 7 to 12,500 thousand cubic feet (Mcf) (average of 3,000 Mcf) of natural gas can be recovered from each cleanup
- Estimate 1 to 580 Bbl of condensate can be recovered from each cleanup



Note: Values for high pressure wells

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 million cubic feet per year (MMcf/yr)
- ❑ Total condensate recovered ~ 6,700 Bbl/yr



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BP Experience

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



Portable Three Phase Separator, Source: BP

Note:

- Value of natural gas at \$1.99/Mcf
- Value of condensate at \$22/Bbl



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Devon Energy Experience

- Implemented Reduced Emission Completion (REC) in the Fort Worth Basin
- REC performed on 30 wells at an average incremental cost of \$8,700
- Average 11,900 Mcf of natural gas sold vs. vented per well
 - ◆ Natural gas flow and sales occur 9 days out of 2 to 3 weeks of well completion
 - ◆ Low pressure gas sent to gas plant
 - ◆ Conservative net value of gas saved is \$50,000 per well
- Expects emission reduction of 1.5 to 2 Bcf in year 2005



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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



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Weatherford Portable Equipment



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Weatherford Green Completions

- ❑ Use natural gas from pipeline along with proprietary foaming agent as compressible fluid to initiate cleanout
- ❑ Cleaning system consists of a wet screw compressor in addition to the booster, three phase separator and sand trap
 - ◆ **Wet screw compressor used when well pressure is less than 80 psig**
- ❑ Estimate a clean up pressure of 300 to 400 psig at a well depth of 8000 feet
- ❑ Suggests use in all kinds of completion and workover cleanup operations



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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?



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