Reducing Methane Emissions from Natural Gas Production: Reduced Emission Completions in Gas Wells and Smart Automation of Gas Well Plunger Lifts

Methane to Markets Partnership Expo
March 4, 2010, New Delhi, India

Don Robinson, Vice President
ICF International
Agenda

- Reduced Emissions Completions
  - Methane Losses
  - Methane Recovery
  - Is Recovery Profitable?
  - Partner Experience
- Plunger Lift and Smart Automation
- Contacts
Methane Losses During Gas Well Completions

- Gas wells in tight formations and coal beds require hydraulic fracture
- It is necessary to clean out the well bore and formation
  - After new completion
  - After well workovers
- Operators produce to an open pit or tank to collect sand, cuttings, and fluids for disposal
- Vent or flare the natural gas produced
- Methane emissions from well completions and workovers are estimated to be as high as 800 million cubic meters per year in the U.S.\(^1\)

\(^1\) Williams E&P, Glenwood Springs, CO

1 - Revised Natural Gas STAR Program emissions estimate.
Methane Recovery by Reduced Emission Completions

- Recover natural gas and condensate produced during flow-back following hydraulic fracture
- Portable equipment separates sand and water, processes gas and condensate for sales
- Route recovered gas through dehydrator and meter to sales line, reducing venting and flaring
Reduced Emission Completions: Preconditions

- Permanent equipment required on site before cleanup
  - Piping from well head to sales line
  - Dehydrator
  - Lease meter
  - Stock tanks for wells producing significant amounts of condensate

- Sales line gas can be used for compressor fuel and/or gas lift in low pressure wells
Reduced Emission Completions: Equipment

- Skid or trailer mounted portable 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

Source: BP

Source: Williams
Reduced Emission Completions: Low Pressure Wells

- Partners and vendors are perfecting the use of portable compressors when pressure in reservoir is low
  - Artificial gas lift to clear fluids
  - Boost gas to sales line
  - Manage slug flow
  - Adds cost to project
Is Recovery Profitable?

- Partners report recovering 2% - 89% (average of 53%) of total gas produced during well completions and workovers
- Estimate 200 – 350 thousand cubic meters (Mcm) of natural gas can be recovered from each cleanup
  - $21,000 to $37,000 savings per completion at $106/Mcm ($3/Mcf)
- Estimate 1 – 580 barrels of condensate can be recovered from each cleanup
  - $50 - $30,000 additional revenue at $50/barrel
- Incremental contracted cost of typical REC is $700 to $6,500/day for 3 to 10 days of well cleanup
- Purchase of REC equipment costs $500,000
  - Payback in 6 to 16 months for 25 well/year drilling program
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Methane Emissions from Liquid Unloading in Gas Wells

- Completion venting is not the only type of well venting
- Accumulation of liquid hydrocarbons or water in the well tubing reduces, and can halt, production
- Operators traditionally blew wells to atmosphere to expel liquids
- 1.8 billion cubic meters of methane emissions from gas well liquid unloading in the U.S.\(^1\)

Source: BP

\(^1\) Revised Natural Gas STAR Program emissions estimate.
Methane Reductions from Plunger Lifts

- Plunger lifts automatically produce liquids without blowing the well to the atmosphere
- Shut-in gas pressure stored in the casing annulus periodically pushes the plunger and liquid load from the well bottom to surface separator
- Wells with the right combination of shut-in pressure, depth and liquid accumulation are kept productive with less operator attention

Source: Weatherford
The Real Benefit is Increased Production

Production Control Services
Spiro Formation Well 9N-27E

Well Production
without Plunger Lift

Potential Continuous
Production with Plunger Lifts

Plunger Lifts Installed

Well Blowdowns
Potential Incremental
Production with Plunger Lift
Is Recovery Profitable?

- Partners report annual gas savings of $90,000 to $130,000\(^1\) per well by the installation of plunger lifts.
- Estimate 130 – 520 Mcm per well of natural gas can be recovered by the installation of plunger lifts.
  - $14,000 to $56,000 savings at $106/Mcm ($3/Mcf).
- Benefits from both increased gas production and emissions savings are well and reservoir specific and vary considerably.
- Cost of implementation ranges from $2,600 to $10,000 per well.
- Purchase of plunger lifts costs about $8,000\(^1\) per well.
  - Payback in 2 to 14 months for incremental gas production ranging from 850 m\(^3\)/day to 85 m\(^3\)/day.

<table>
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<th>Gas Price (U.S.$/Mcm)</th>
<th>$106</th>
<th>$177</th>
<th>$247</th>
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<tbody>
<tr>
<td>Payback (months)</td>
<td>2.8</td>
<td>1.9</td>
<td>1.5</td>
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<td>NPV (U.S.$)</td>
<td>120,630</td>
<td>176,157</td>
<td>231,684</td>
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1 - EPA Lessons Learned 2006, “Installing plunger lift systems in gas wells.”
Smart Automation Well Venting

- Automation can enhance the performance of plunger lifts by monitoring wellhead parameters
  - Tubing and casing pressure
  - Reservoir pressure recovery time
  - Sales line pressure
  - Flow rate
  - Plunger travel time

- Using this information, the system is able to optimize plunger operations
  - To minimize well venting to atmosphere
  - Recover more gas
  - Further reduce methane emissions
Smart Automation Partner Experience: BP

- BP’s first automation project designed and funded in 2000
- Pilot installations and testing in 2000
  - Installed plunger lifts with automated control systems on ~2,200 wells
  - ~$15,000 per well Remote Terminal Unit (RTU) installment cost
  - $50,000 - $750,000 host system installment cost
- Achieved roughly 50% reduction in venting from 2000 to 2004
Smart Automation Partner Experience: BP

Daily Vent Volumes

Vent Rate (Mscfd)

Year

Source: BP
Is Recovery Profitable?

- Estimate 180 – 700 Mcm per well of natural gas can be recovered by the installation of smart automation
  - $19,000 to $74,000 savings at $106/Mcm ($3/Mcf)
- Benefits from significant reductions in gas venting volumes along with production improvements
- Automation System can be installed at a cost of less than $12,000 per well
  - Payback in 1 to 3 years

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<th>$247</th>
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<td>Payback (months)</td>
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<td>NPV (U.S.$)</td>
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