Opportunities for Methane Emissions Reductions from Natural Gas Production

Lessons Learned from Natural Gas STAR

Producers and Processors Technology Transfer Workshop

ConocoPhillips and EPA's Natural Gas STAR Program
Kenai, AK
May 25, 2006

Agenda

- Smart Automation Well Venting
  - Methane Losses
  - Methane Recovery
  - Is Recovery Profitable?
  - Industry Experience
  - Discussion Questions
- Reduced Emissions Completions
  - George Jackson, Devon Energy

Smart Automation Well Venting

- Automation can enhance the performance of plunger lifts by monitoring wellhead parameters such as:
  - Tubing and casing 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

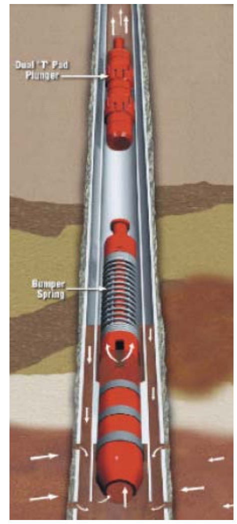
Methane Losses

- There are 390,000 natural gas and condensate wells (on and offshore) in the US[1]
- Accumulation of liquid hydrocarbons or water in the well bores reduces, and can halt, production
- Common "blow down" practices to temporarily restore production can vent 80 to 1600 Mcf/yr[2] to the atmosphere per well
- Estimate 9 Bcf/yr methane emissions from U.S. onshore well venting[1]

1 - Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2004
2 – Mobil Big Piney Case Study 1997

What is the Problem?

- Conventional plunger lift systems use gas pressure buildups to repeatedly lift columns of fluid out of well
- Fixed timer cycles may not match reservoir performance
  - Cycle too frequently (high plunger velocity)
    - Plunger not fully loaded
  - Cycle too late (low plunger velocity)
    - Shut-in pressure can't lift fluid to top
    - May have to vent to atmosphere to lift plunger



Source: Weatherford

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Conventional Plunger Lift Operations

- Manual, on-site adjustments tune plunger cycle time to well's parameters
  - Not performed regularly
  - Do not account for gathering line pressure fluctuations, declining well performance, plunger wear
- Results in manual venting to atmosphere when plunger lift is overloaded

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Methane Recovery: How Smart Automation Reduces Methane Emissions

- Smart automation continuously varies plunger cycles to match key reservoir performance indicators
  - Well flow rate
    - Measuring pressure
  - Successful plunger cycle
    - Measuring plunger travel time
- Plunger lift automation allows producer to vent well to atmosphere less frequently

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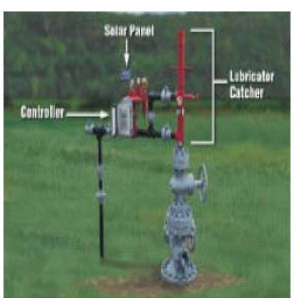
Automated Controllers



Source: Weatherford

- Low-voltage; solar recharged battery power
- Monitor well parameters
- Adjust plunger cycling

- Remote well management
  - Continuous data logging
  - Remote data transmission
  - Receive remote instructions
  - Monitor other equipment

Source: Weatherford

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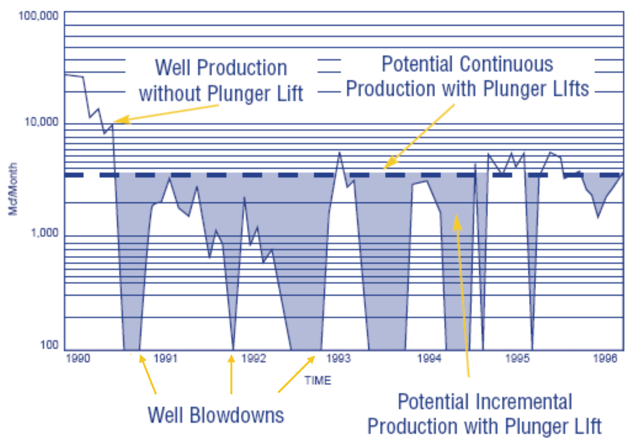
Plunger Lift Cycle

Production Control Services
Spiro Formation Well 9N-27E



Methane Savings

- Methane emissions savings a secondary benefit
  - Optimized plunger cycling to remove liquids increases well production by 10 to 20%[1]
  - Additional 10%[1] production increase from avoided venting
- 500 Mcf/yr methane emissions savings for average U.S. well

1 – Reported by Weatherford

Other Benefits

- Reduced manpower cost per well
- Continuously optimized production conditions
- Remotely identify potential unsafe operating conditions
- Monitor and log other well site equipment
  - Glycol dehydrator
  - Compressor
  - Stock Tank
  - VRU

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Is Recovery Profitable?

- Smart automation controller installed cost: ~$11,000
  - Conventional plunger lift timer: ~$5,000
- Personnel savings: double productivity
- Production increases: 10% to 20% increased production
- Savings =

  (Mcf/yr) x (10% increased production) x (gas price)
  \+ (Mcf/yr) x (1% emissions savings) x (gas price)
  \+ (personnel hours/yr) x (0.5) x (labor rate)

  $ savings per year

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Economic Analysis

- Non-discounted savings for average U.S. Well =

  (50,000 Mcf/yr) x (10% increased production) x ($7/Mcf)
+ (50,000 Mcf/yr) x (1% emissions savings) x ($7/Mcf)
+ (500 personnel hours/yr) x (0.5) x ($30/hr)
- ($11,000) cost

$35,000 savings in first year

3 month simple payback

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Industry Experience

- BP reported installing plunger lifts with automated control systems on ~2,200 wells
  - 900 Mcf reported annual savings per well
  - $12 million costs including equipment and labor
  - $6 million total annual savings
- Another company shut in mountaintop wells inaccessible during winter
  - Installed automated controls allowed continuous production throughout the year[1]

1 - Morrow, Stan and Stan Lusk, Ferguson Beauregard, Inc. Plunger-Lift: Automated Control Via Telemetry. 2000.

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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 this opportunity 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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