Plunger Lift: Opportunity, Optimization and Opposition (and even some Optimism!)

David Green, P.Eng., EVP & CTO, Well Master Corp.
Jesse Smith, President, Optimal Production Solutions

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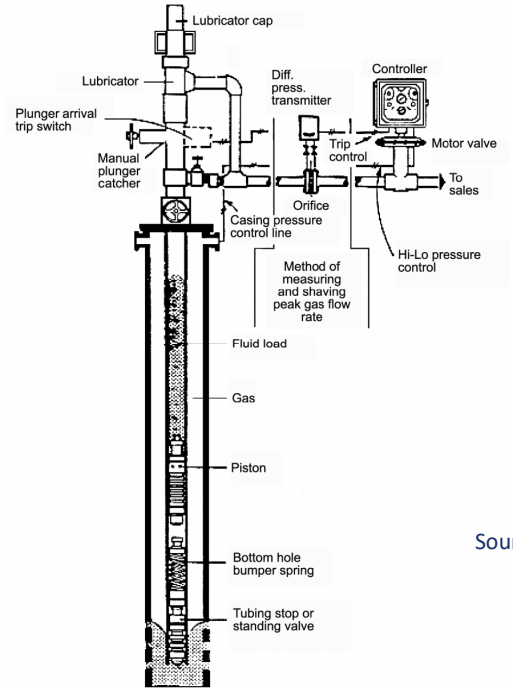
Overview of Plunger Lift

- Initially developed to deliquify “marginal” gas wells that were typically intermitted to unload liquids
- A simple concept…. A free traveling “piston” that falls to the bottom of the tubing during shut-in and is then driven by gas pressure from the formation to lift liquids to surface
- Expanded in the past 20 years to include higher producing wells with bypass-style plungers that can fall against flow
- Applicable to a wide range of wells, gas wells and “gassy” oil wells
- Very low CAPEX and OPEX
- Can be very low emissions with proper design and equipment



Source: Petrowiki, Plunger Lift Pages

So… What Are Some Drivers of the Problem of Underperforming Plunger Lifted Wells?

- Largely a trial-and-error process.
- Challenging to become highly skilled (Black Magic! Voodoo!).
- Challenging to transfer skills to new employees.
- Wide variation of industry practice for training. Mostly safety oriented.
- Lack of fundamental physics knowledge at many levels.
- Engineers not focused nor interested?
- Engineers get little formal education on plunger lift in school.

Opportunity

- We are in a world of $100+ oil and $8+ natural gas
- Events in Ukraine/Europe highlight weaknesses in too-rapid roll out of green energy programs
- Drilling is constrained by:
  - Financial pressure (remember the bankruptcies of many shale producers)
  - Increased regulatory requirements
  - Political forces against “fossil fuels”
- This leaves optimization of existing assets as a highly effective way to increase production and capitalize on the current prices
- Timeliness: Applying optimization strategies effectively has rapid payback, especially in the current environment.

What is an Optimized Plunger Lift Well?

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What Can We Optimize?

1. Time
   - Only have 24/7/365 to work with and lots of tasks/duties
2. Plungers
   - Go up and down, don't miss trips, no fast arrivals
3. Wells
   - What the well can produce versus what we can get from the well.

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Another Aspect About Optimization: It's all about the money…

- Income statement → Cash Flow
- Balance Sheet → Asset Valuation

These are important business metrics and every well is a business….

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Income Drives Cash Flow

At the field operations level we have the most influence here:

Revenue
- Direct Cost
= Gross Margin/Profit
- Overheads
- PEOPLE
- etc.
= Operating Profit/Loss

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Economic Drivers

- What is the value of an increment of gas?
  - At today's gas prices a good rough value is 10 mcf/d equates to about $30,000 per year or top line revenue (Plus or minus – what would you prefer?)
- What is the value of an increment of oil/condensate?
  - Similarly, a good rough value is 1 bbl/d equates to about $40,000 per year of top line revenue (Again, plus or minus, what do you prefer?)
- Multiply these numbers by the number of wells you have to understand the bigger picture! Ex. $30,000 per well x 1000 wells = $30,000,000 per year!

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Optimizing Production is Urgent!

- Why?
  - If we do not recover what the well can produce (producing below the natural decline) in the near term, when do we get it?
  - We must consider deferred production as lost production!
  - Production pushed to the end of the life of the well may never get recovered.
  - Operating below the natural decline reduces EUR and the well reaches P&A sooner.
  - **Deferring production defers cash flow and devalues the asset.**

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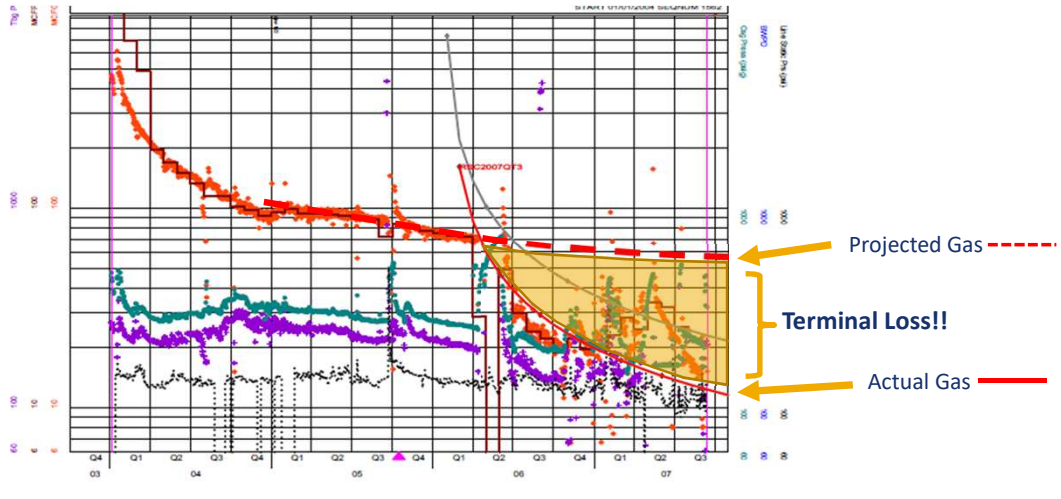
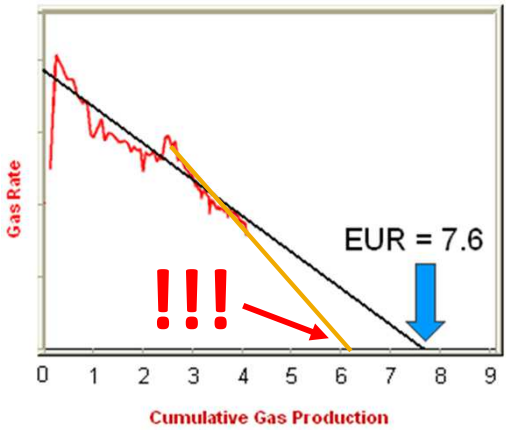
Terminal Losses



Optimization Drives Asset Value

- Recoverable reserves drive asset values



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Opposition

Why Do We Struggle to Capture the Full Opportunity?

- "We're already there!"
- Optimized well definition inappropriate
- Lack of training, or ineffective training
- SOP's ("we complete and operate all wells the same")
- Failure to get buy-in across all levels of the organization
- Perceived loss of power of field-level employees
- Expanded use of plungers in HZ and PAGL/GAPL not well understood (paradigms of vertical wells don't' work, e.g. Turner/Coleman V_{CRIT})

Opposition – what else?

- Misunderstanding LOE
- A cost-focused business model that goes too far or is driven by the previous price environment or driven by financial backers
- Engineers and Foremen too busy and defer to LO's
- Lack of statistically relevant testing (tried it once and it failed!)
- Lack of patience
- Lag time between input changes and output results confuse the cause/effect relationship

Optimism – How to Move Forward

- Get aligned from upper management to field level as to strategy, intent and goals
- Provide training that is comprehensive
- Include other disciplines in training: e.g. procurement, gathering
- Develop internal “champions” and SME’s
- Provide feedback to create a “virtuous cycle”

The Future

- Data driven world! Set up to collect, store and analyze data.
- Artificial Intelligence / Machine Learning for medium to long term trend analysis, optimization guidance, preventive maintenance, predictive studies, etc.
- Application of Edge devices to push computing power, AI/ML to short-loop (high frequency) control at the wellhead.

QUESTIONS?

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