2024 GAS LIFT WORKSHOP

Surface Controlled Gas Lift Optimization Vision

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Agenda

- SCGL Overview
- Automation
- Optimization & Future Potential
- Production Analysis
- Issues with Traditional Gas Lift
- Data Integration
- Conclusion
- Questions

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Surface Controlled Gas Lift Valve

- Variable Orifice: 0 – 3/8” Port Sizes
- Pressure Sensors: Tubing & Annulus
- Temperature Sensors: Tubing & Annulus
- Single ¼” Electrical Control Line
- Mandrel can be adapted to tubing size.

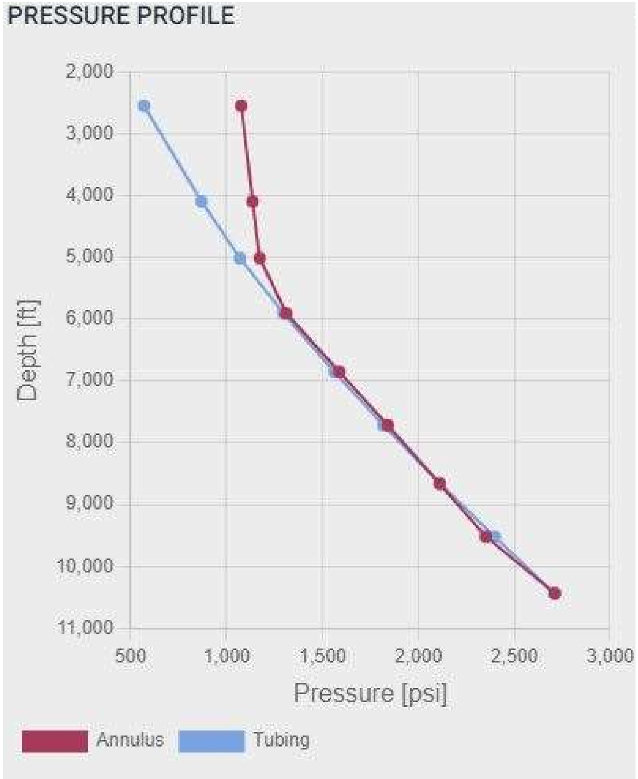
Automation

- Reactive automation software that adjusts port size, depth of injection, or shuts in based on changing surface and well conditions.

- System maintains stable injection by adjusting orifice size to maintain a set differential pressure across the operating valve.

- Adjustable control parameters to adapt to well characteristics
  - Orifice adjustment increments
  - Control timing intervals
  - Criteria to establish deeper point of injection
  - Differential across operating valve.

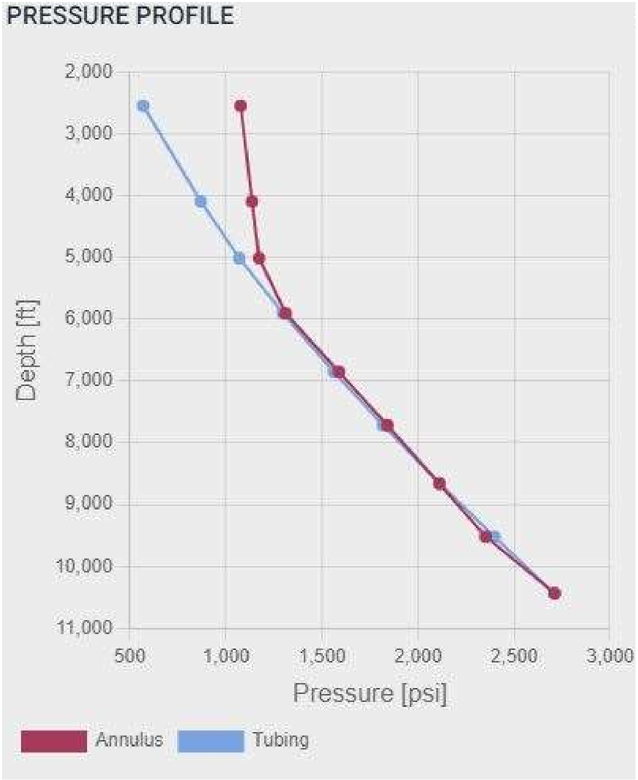
- Structure in place for utilizing customer-specified algorithms



Automation

State Driven Machine

- Shut in
- Establish Injection
- Maintain Injection
- Walk Up
- Walk Down



Benefits of Surface Controlled Gas Lift

Increased Injection Depth

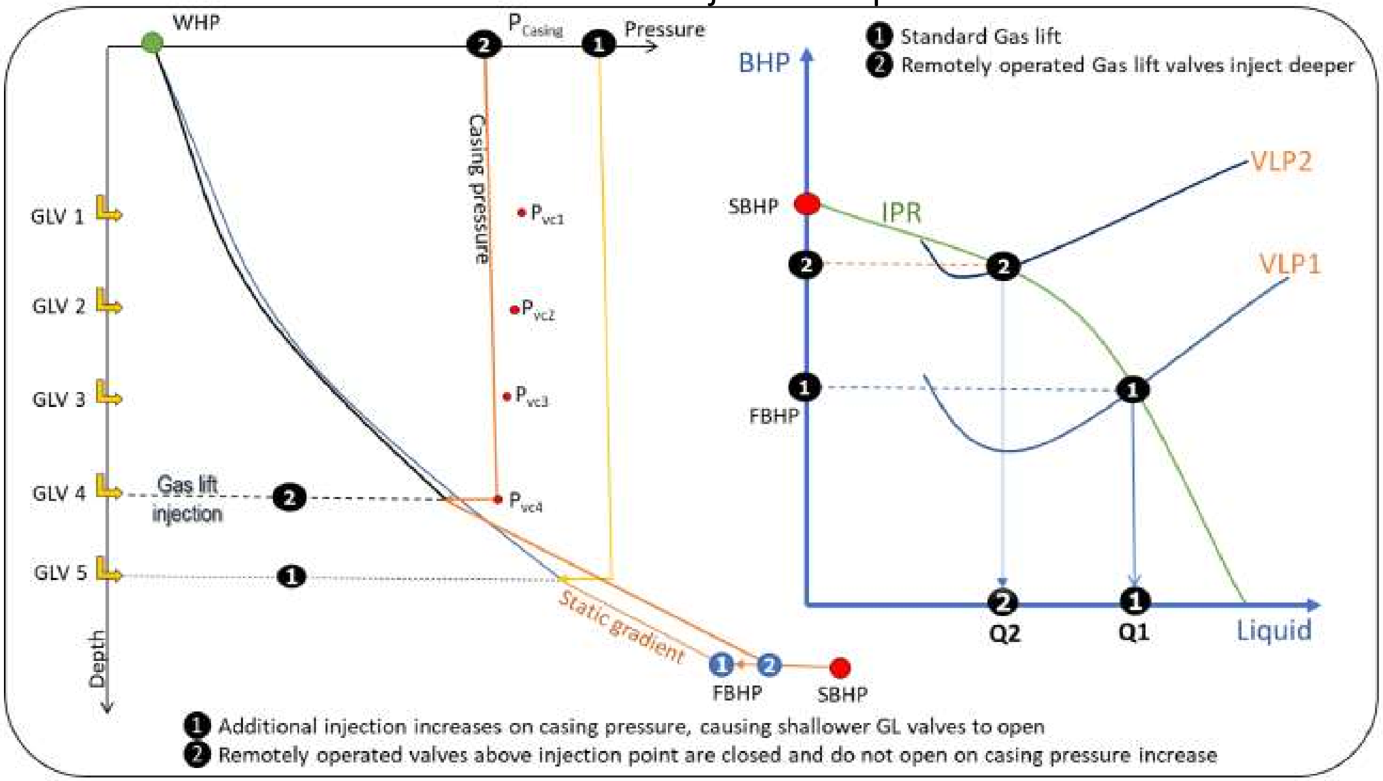


Figure 3—Pressures and depths of injection comparison between conventional and remotely operated Gas lift valves with production effects

Visser, Johannes , and Tomislav Basic. "Pilot Application of Remotely Operated Gas Lift Valves in Permian Basin Unconventional Wells." Paper presented at the SPE Artificial Lift Conference and Exhibition - Americas, Virtual, November 2020. doi: https://doi.org/10.2118/201140-MS

Switch Injection Rate Control

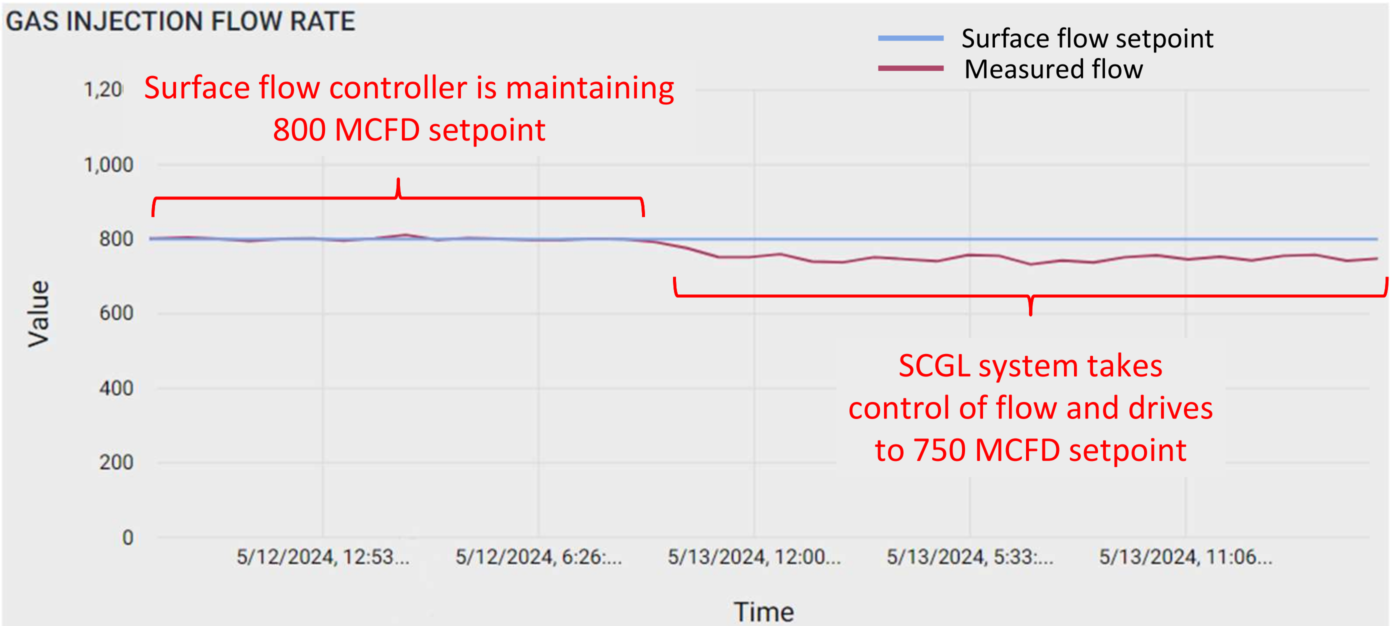
Switch injection rate control

Typically, Gas injection rate is controlled at surface by automatic or fixed injection chokes. By using remotely operated gas lift valves, ability to control which gas lift valve is open and at which port size leads to a different operating philosophy, i.e. actively controlling injection rate downhole, rather than at surface.

Visser, Johannes , and Tomislav Basic. "Pilot Application of Remotely Operated Gas Lift Valves in Permian Basin Unconventional Wells." Paper presented at the SPE Artificial Lift Conference and Exhibition - Americas, Virtual, November 2020. doi: https://doi.org/10.2118/201140-MS

Switch Injection Rate Control

- Currently trialing new automation logic that controls valve openness based on surface injection gas rate.



Future Potential

Existing Optimization

- Ensures maximum injection depth
- Provides stable injection – maintains a set differential pressure
- Efficient use of injection gas – no unwanted multi-pointing

Optimization Vision

- Autonomously determine the optimal injection rate.
- Measure and control the injection rate downhole.

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Measuring Injection Rate Downhole

Injection Rate Calculator

- Valve Position
- + Temperature
- + Gas Gravity
- + Pressure Data

Flow Rate

Units: Field

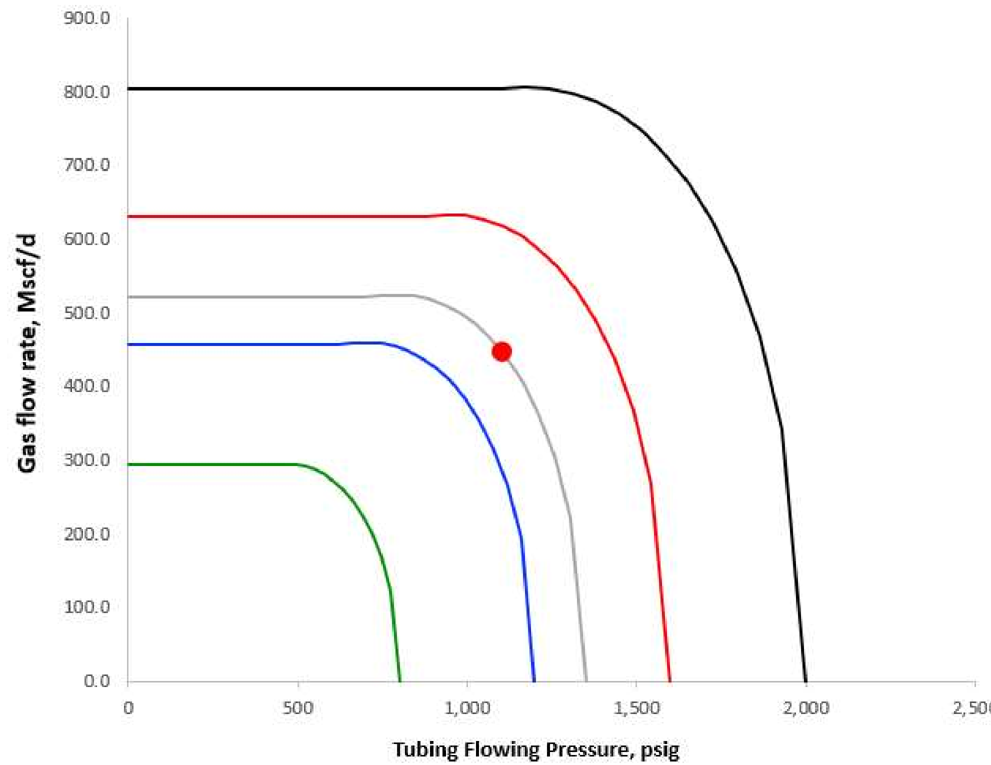
Valve input data

Fluid phase	Gas	
Valve model	Model 1	
Valve Opening	10	%
Fluid temperature	150.0	F
Fluid specific gravity	0.9	-

Custom point & curve

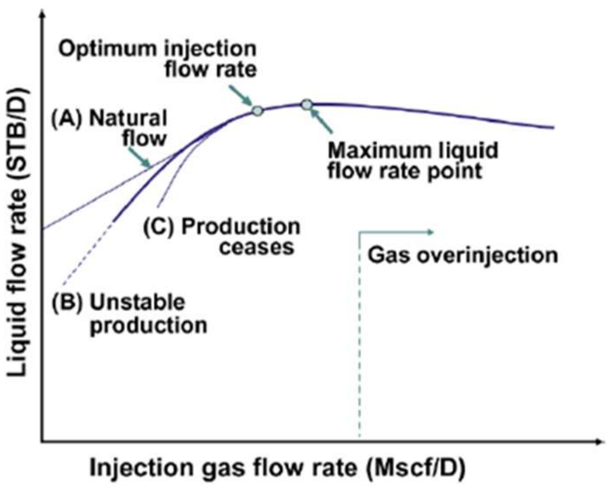
Custom curve pressure	1,350	psig
Downstream pressure	1,100	psig
Gas flow rate	449.00	Mscf/d

Update curves

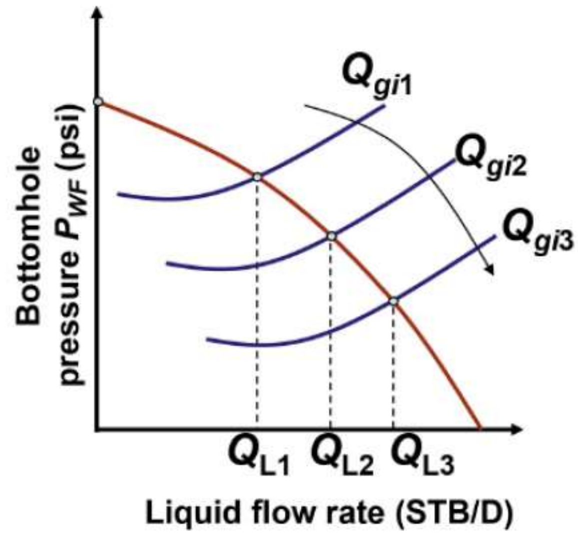


Finding the Optimal Rate

Step Rate Testing



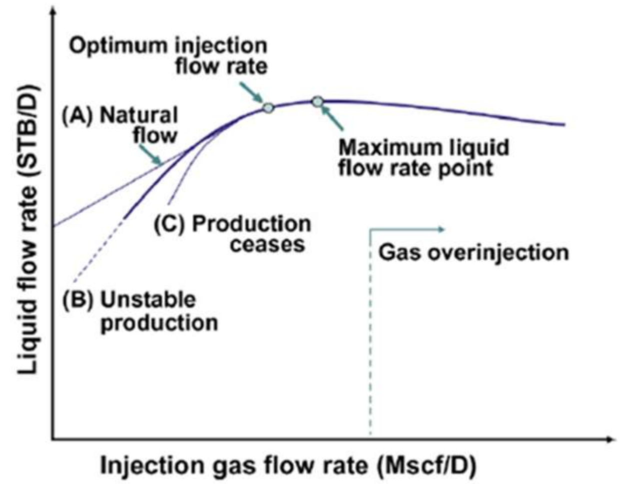
Nodal Analysis



Hernández, A. (2016). *Fundamentals of Gas Lift Engineering: Well design and Troubleshooting*. Gulf Professional Publishing.

Traditional Step Rate Testing

- Reliant on production data
  - Infrequent testing
  - Requires operator interaction
- What is an independent alternative?



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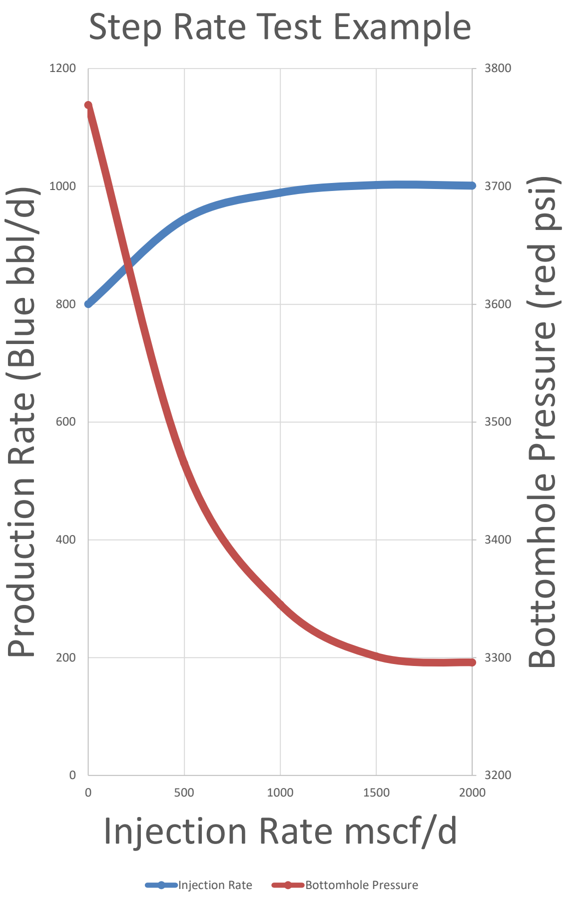
Modifying the Step Rate Test:

Well-level optimization scenario

Compare how injection rate affects rate of bottomhole pressure decline.

- System won't need to rely on production data to determine optimal rate.
- Determine which injection rate creates the greatest bottomhole pressure decline



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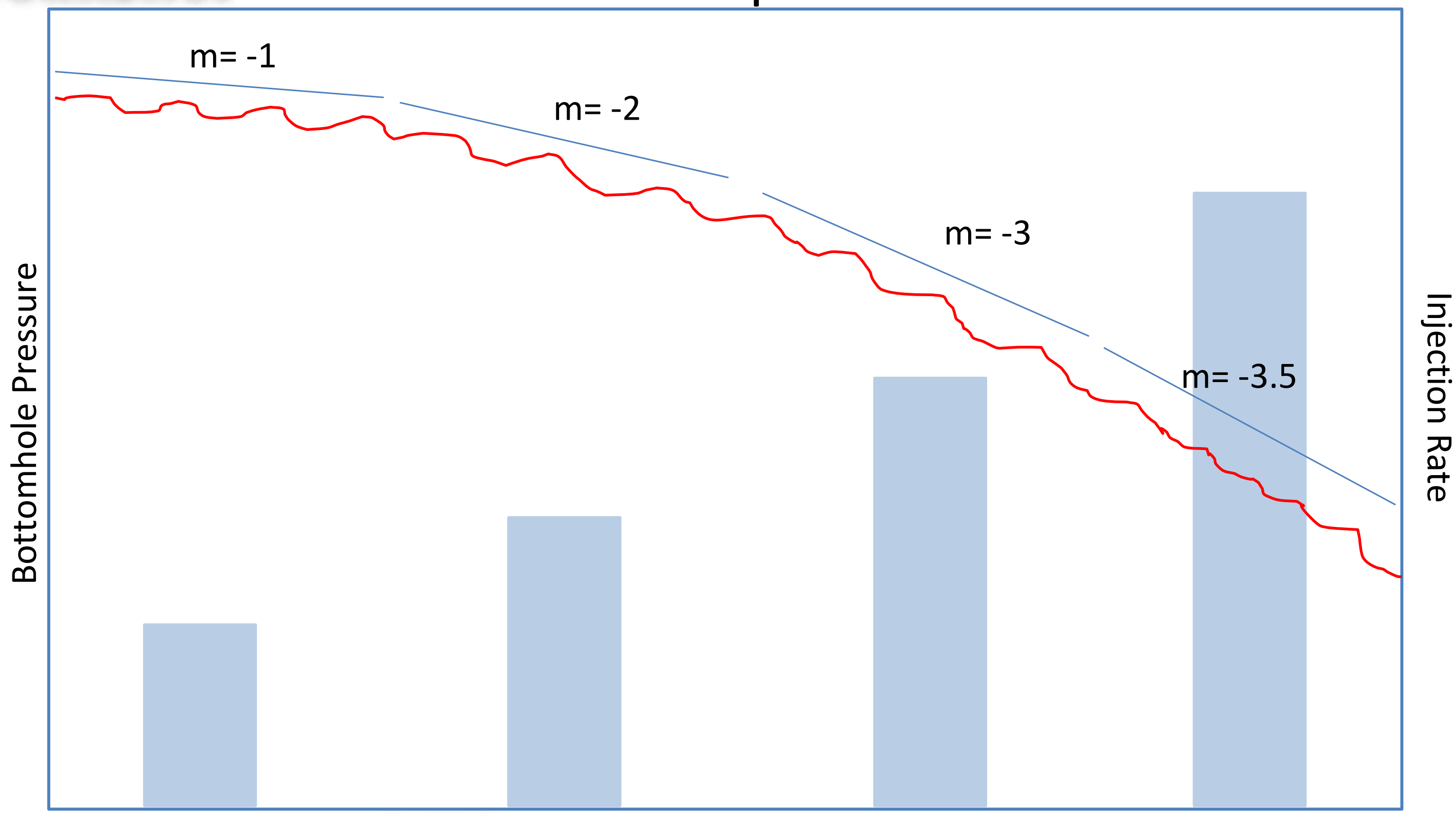
Modified Step Rate Test



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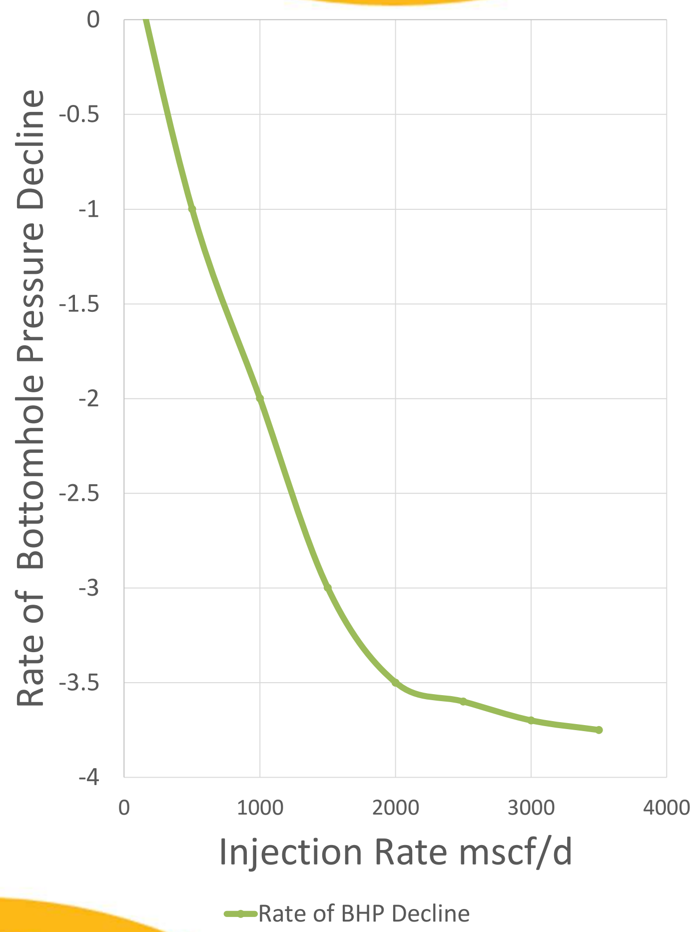
Modified Step Rate Test



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Modifying the Step Rate Test:

Gas constrained multiple-well optimization scenario

Use current Productivity Index for each well within automation logic

Productivity Index = bbl/day/psi of drawdown

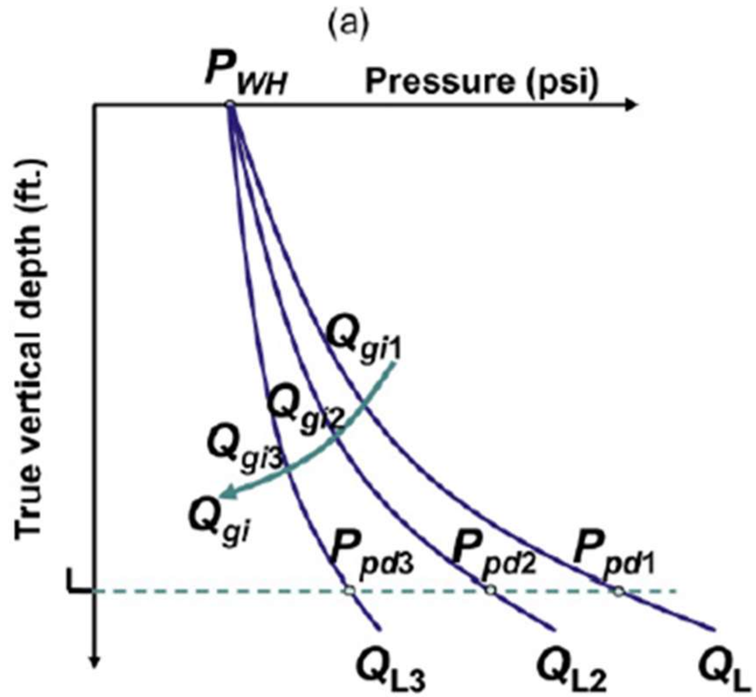
- Relate bottomhole pressure to production within the logic.
- Allocate gas to most deserving wells.

Nodal Analysis

Benefits

- Gas lift Sensitivities
  - Theoretical approach to determining optimal gas lift rate rather than an iterative practical approach with step-rate testing

- Accurately determine multiphase flow correlation



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Gas Lift Optimization with SCGL

- Opportunities exist for an SCGL to independently optimize injection rate on a well-to-well basis.
- Automated optimization for an entire field becomes increasingly more complex when gathering and production networks are considered.
- SCGL can provide additional levels of data and points of control to enhance existing optimization models and gas distribution networks.

Increasing Complexity

Table 1: Key developments. The evolution of approaches developed for the treatment of the gas-lift optimization problem.

Merits	Limitations
Performance curve generation	
Provides well production relationship with GLIR	Well test requirements Well test data quality
Nodal analysis	
Well model simulation	Fluid data assumptions
Multi-phase flow modeling	P and T assumptions
Performance curve generation	Primarily for single well
Curve-based models	
Fast, analytical models	Neglect well interations
Considers all wells	Curve fitting and quality
Simple to evaluate	Pseudo steady state solution
Network simulation	
Rigorous simulation models	Evaluation cost
Includes well interactions	Model smoothness
Handles looped models	Steady state solution
Handles facility components	Gradient information
Coupled simulation	
Detailed coupled system	Coupling scheme
Rigorous interaction	Model robustness
Includes transient effects	High computation cost
	Gradient information
Integrated asset modeling	
Comprehensive system dynamics and interactions	Coupling procedures Model robustness
Simulation over asset life	High computation cost
	Gradient information

Kashif Rashid, William Bailey, Benoît Couët, "A Survey of Methods for Gas-Lift Optimization", Modelling and Simulation in Engineering, vol. 2012, Article ID 516807, 16 pages, 2012. https://doi.org/10.1155/2012/516807

Gas Lift Optimization with SCGL

- Valve Percentage > Port size
- Controlling injection gas sub-surface
- Maximizing compression output
- Can switching to Annular Lift after long shutdown and load up provide accelerated BHP drawdown?
- Increased run life and production

SCGL vs Annular Gas Lift Comparison

- How does SCGL compare with Annular flow?

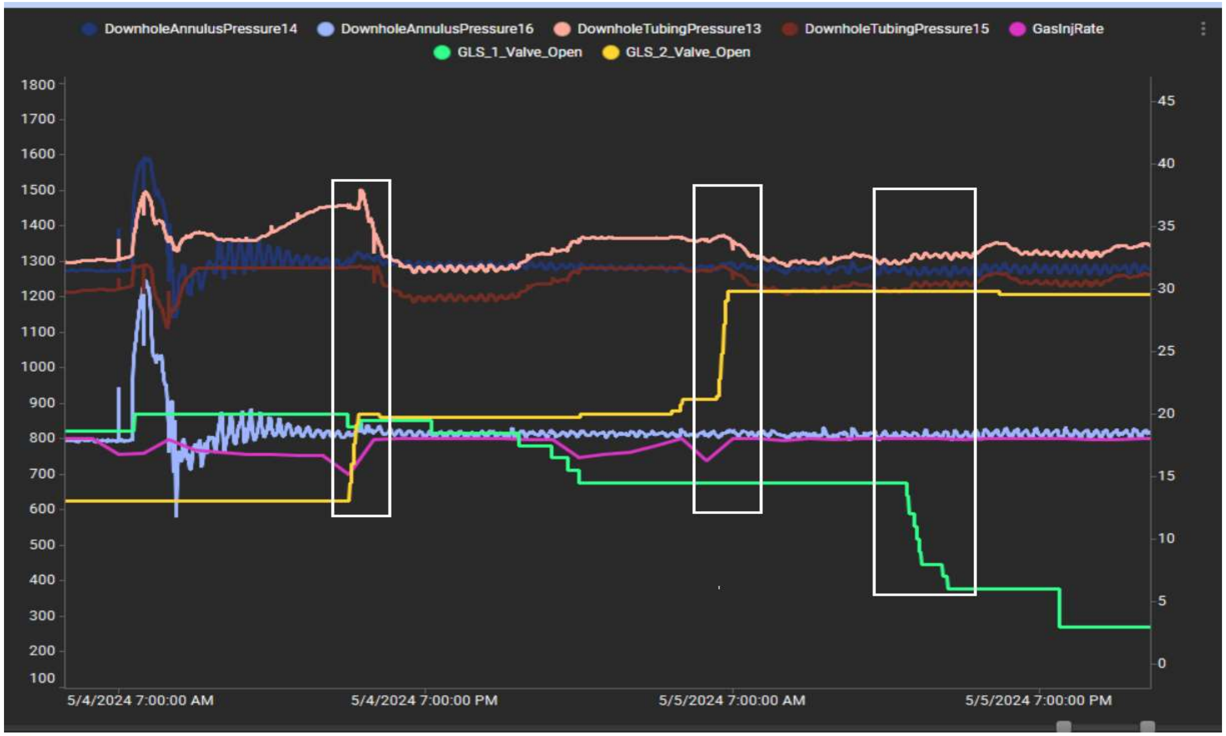
Lift Method	POP	Production Days	Avg BOPD	Liquid Prod (bbl)	Gas Prod (mscf/d)	Top Perf (ft)	Btm Perf (ft)	Total Perf	MD (ft)	TVD (ft)	KOP (ft)
Annular GL	10/04/2023	242	**1,459**	1,047,938	852,429	11,431	27,293	15,862	27,722	11,480	10,748
EGL Annular	11/03/2023	214	**1,604**	1,080,275	818,855	11,247	27,440	16,193	27,741	11,418	10,631
EGL Annular	11/04/2023	213	**1,672**	1,225,290	838,163	11,157	27,573	16,416	27,670	11,348	10,576

BHP Decline

- Faster drawdown with less Injection
- Flowing back with SCGL system vs IPO’s

Optimization Through Valve Control

- Efficient multi point Injection
- Dictating staging down without the thought of dropping injection pressure.
- Control closest to the injection point vs at surface.



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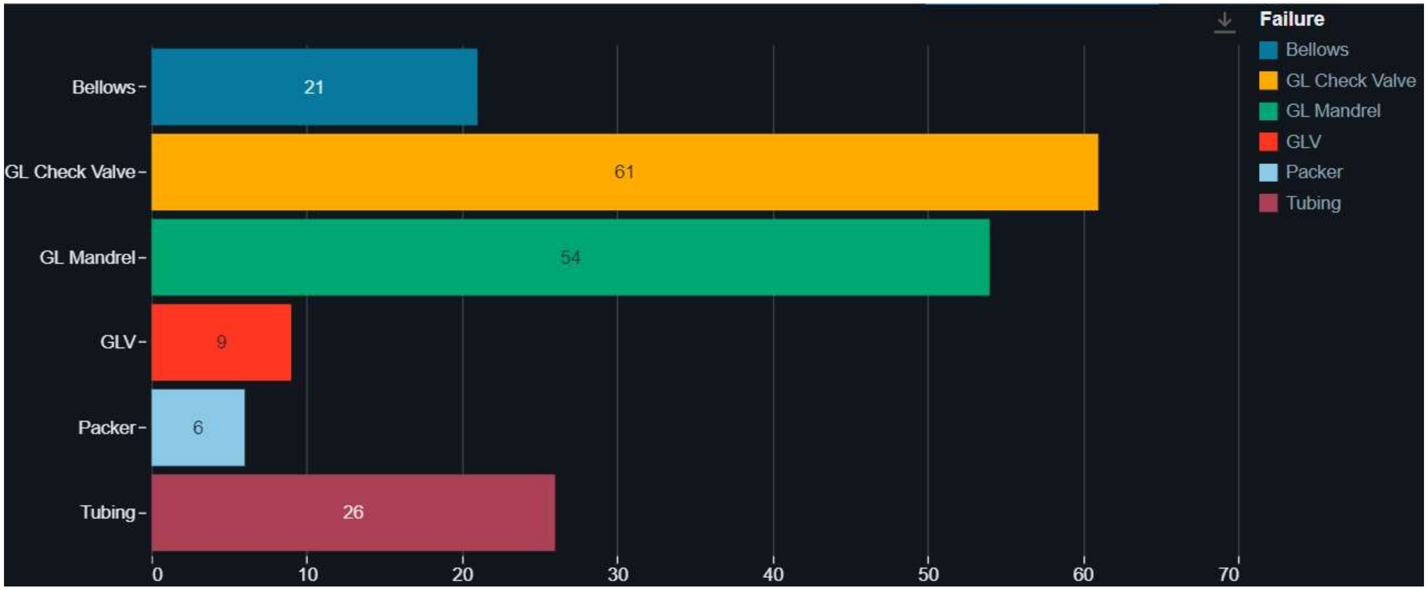
Gas Lift Failure Analytics

- Mitigating GLV failures through valve control
- What is the cost of failures?



Data Integration

- How do we get SCGL data and what is the future for expansion?
  - Data dumps to API connector
  - Data Modeling Process
  - Is SCADA integration worth it?
  - Cyber Security process and procedures

- Real Time Optimization
  - Automated kick off following downtime event
  - Automated Setpoint adjustments
  - Adjusting Injection Rate downhole

Future Development

Interested in additional installations, pending comprehensive analysis:

- Economics: Production optimization, injection gas utilization
- Operations: Reduced downtime, reduced number of interventions
- Reliability: Remote monitoring – troubleshooting, robustness
- Comparison to other artificial lift technologies: production efficiency, adaptability to changing well conditions, cost-effectiveness.

Question Time

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